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ECONOMIC GEOGRAPHY

JANUARY

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FUTURE POPULATION IN CANADA
Griffith Taylor

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CABINET WOODS

ONLY a few of the many woods that lend themselves to man's economy can be used for furniture and interior decoration of his home, his wainscoting and staircases, his door and window frames, his floors and ceilings and exposed beams, his mantels and his cabinets. Of the few, still fewer are superior, most but mediocre. The few come from widely scattered areas over the world's forests, from native habitats highly different in terrain, and soil, and climate.

Of cabinet woods, none ranks higher in popular fancy and esteem than mahogany, unless it be temperate walnut or tropical rosewood. Mahogany has gained high regard among the peoples of the world for finest and most durable furniture and interior decoration. It is relatively scarce; hard to find, lumber, and transport to market; confined to the tropics or subtropics where disease and pests infest the dank forests where it grows.

Once found and brought to the world's great centers of wealth and art and culture, it satisfies the craftsman's most exacting demands. It does not warp, or crack, or dent, or bend easily. It changes character little, if at all, with heat or cold, dampness or drouth. It yields readily to sharp and precise tools. Straight-grained and uniform in texture, it splits, and saws and carves tractably under the craftsman's skilled hands, taking such exquisite forms as his designs prescribe. Hard enough to resist denting or scratching or other marring, it takes lustrous polish, and retains it like satin. It is not too heavy for handling, nor too light for stability.

Mahogany, rosewood, and walnut form the craftsman's and artist's trinity of royal cabinet woods, superior to oak, and cherry, and liquidambar, and maple, and birch, and all the other woods that lend themselves well to the cabinet-maker's art. Each one of the trinity has its own distinctive qualities that endear it to the hearts of folk who use it and treasure it.

ECONOMIC GEOGRAPHY

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MAHOGANY INDUSTRY OF PERU

Harry E. Hoy

THE mahogany industry of the Peruvian Amazon is a recent development. Although trees "resembling Spanish Mahogany" were reported in the sixteenth century, they were utilized only for fuel and construction. By 1900 a few mahogany logs were rafted annually to Manaus and Belem and there exported as Brazilian mahogany. Not until 1920 were saw mills erected near Iquitos.

In Peru the names "aguano" and "caoba" are locally applied to mahogany. In some areas the inhabitants maintain that caoba is correct, in others, aguano is insisted upon with equal fervor. Moreover, different botanical names have been given from time to time. Raimondi in 1861 identified the Peruvian mahogany tree as "Swietenia mahagoni," saying that it was the same species as that found in Cuba and other islands of the West Indies. Delboy recently applied the name "Swietenia tassmania" which had earlier been recommended by Harms. Some American botanists consider it to be the same as the Swietenia macrophylla, King, of Central America. There are physical differences in the wood but it seems doubtful that they are sufficient to warrant the naming of a new species.

DESCRIPTION OF THE MAHOGANY TREE

Wild mahogany grows in association with hundreds of other species; never in pure stands. Although its distribution is far from uniform in the "montaña," the minimum physical requirements of the tree seem to be met throughout the lowlands drained by the Amazon and its tributaries of eastern Peru. In the Iquitos area, mature trees range from 150 to 200 feet tall. The mahogany is one of the tallest in the forest. Trees in the selva grow rapidly because of the continuous death struggle for space in the sunlight. As a result the trunk is straight and all branches are high up in the crown of the tree. This makes it possible to cut four to six logs from a bole. The light gray bark is fairly smooth except on old trees. The compound leaf resembles that of the American ash or hickory. The leaves are light green in color; they present a fresh cool appearance and glisten in the sunlight as though covered with shellac.

PHYSICAL REQUIREMENTS OF MAHOGANY

Climatic records are scarce in the Amazon region of Peru, even the best record, that of Iquitos, covers only

scattered periods of short duration. The accuracy of certain of these records may be questioned because of the poor locations of the thermometer and rain gauge.

The climate of Loreto, the department from which most of the Peruvian mahogany comes, may be considered the Rainy Tropical (Afwi after Koppen). The temperature is continuously warm; the warmest month (November) averages 80 degrees F.; the coolest (June) is 77 degrees F. The heat is not overly oppressive. The highest recorded temperature is 95 degrees F., and the lowest 62 degrees F. The annual range of temperature is so small that differences between the mean temperatures of the same month in successive years is apt to be larger than the annual range. For example: May in 1941 had a mean temperature of 84 degrees F., in 1943 it was 76 degrees F., almost three times the mean annual range.

The annual precipitation ranges considerably above and below 100 inches. The year is divided into a rainy and a less rainy season. The period from November through April is the rainy season or "invierno" (winter), the period from May to the end of October the less rainy or "verano" (summer). Note that the names for the seasons do not correspond to the actual temperature seasons nor to the position of the sun, but to cloud cover and sensible temperatures. No month is ordinarily rainless but August is usually the driest month. In 1941 the August precipitation was 1.3 inches, but in 1942 it was 5.2 inches.

The prevailing wind is from the east but it rarely blows with a high velocity. The sky is covered with cloud for at least a part of every day and the existence of a continuous overcast for several days, perhaps accompanying a tropical low pressure area, is more frequent than commonly supposed.

FIGURE 1.—Aguascaliente, a small port on the Pachitea River. Much of the gasoline and lubricating oil used in Eastern Peru is produced by the Anzo Azul Oil Company whose refinery is near the right side of the picture. The great height of the forest may be seen along the roadways and clearings.

Although the mahogany tree is able to survive periods of overflow it does not grow on the low-lying areas that are submerged for several months. Mahogany is a tropical lowland tree but it is significant that the logs from the Pachitea River, which drains land higher than the other rivers, are of the best quality reaching Iquitos (Figure 1).

Mahogany responds to soil differences on plantations, but how much the size of the wild tree is due to soils and how much to drainage, slope, exposure, and competition cannot be definitely stated.

FIGURE 2.—Tropical Forest Regions of Peru.

DISTRIBUTION OF MAHOGANY

More than one-half or approximately 400,000 square miles of Peru's total area of 659,000 square miles is forested (Figure 2). Most of this is tropical lowland; all of it is located east of the main ranges of the Andes on the steep-sided foothills and the broad, flat to undulating plain of the upper Amazon and its tributaries. Even though this vast area has been traversed time and again, little of a quantitative character is known of its forest resources. After completing a brief survey of the forest resources of Peru in 1943, Cox concluded that the range of mahogany is great in the "montaña" although its density varies from place to place. In some areas there may be one or more mahogany trees to the acre but more often they are a mile or more apart.

No accurate inventory has been taken of where the best trees are located nor how great is the reserve. The result is that some areas have been intensively exploited to the point of exhaustion, others skimmed and abandoned and no doubt other rich stands are still untouched.

The distribution of exploited areas is widely scattered, both between operators and within the zone of one operator. Some rivers produce no logs. Whether this is because operations have not been extended to them, or there are too few trees, is not always known. The rivers supplying the greatest number of logs to the mills at Iquitos, in their decreasing order of importance, are the Ucayali, Huallaga, Marañón, Pachitea, Tapiche, and Nanay. However the rivers supplying the best logs in the order of their excellence are the Pachitea, Marañón, Nanay, Ucayali, Huallaga, and Tapiche.

It is claimed that the finest area of caoba, as well as rubber, occurs in the Department of Madre de Dios in the southeast of Peru. This is a part of the Acre region which Peru shares with Brazil and Bolivia. At present there is no cutting of mahogany there. The

FIGURE 3.—Isolated Indian hut on a low terrace above the level of high water on the Upper Marañón (visible in the upper left corner). Some conception of the diverse species found in the tropical forest may be gained from this as well as Figure 1.

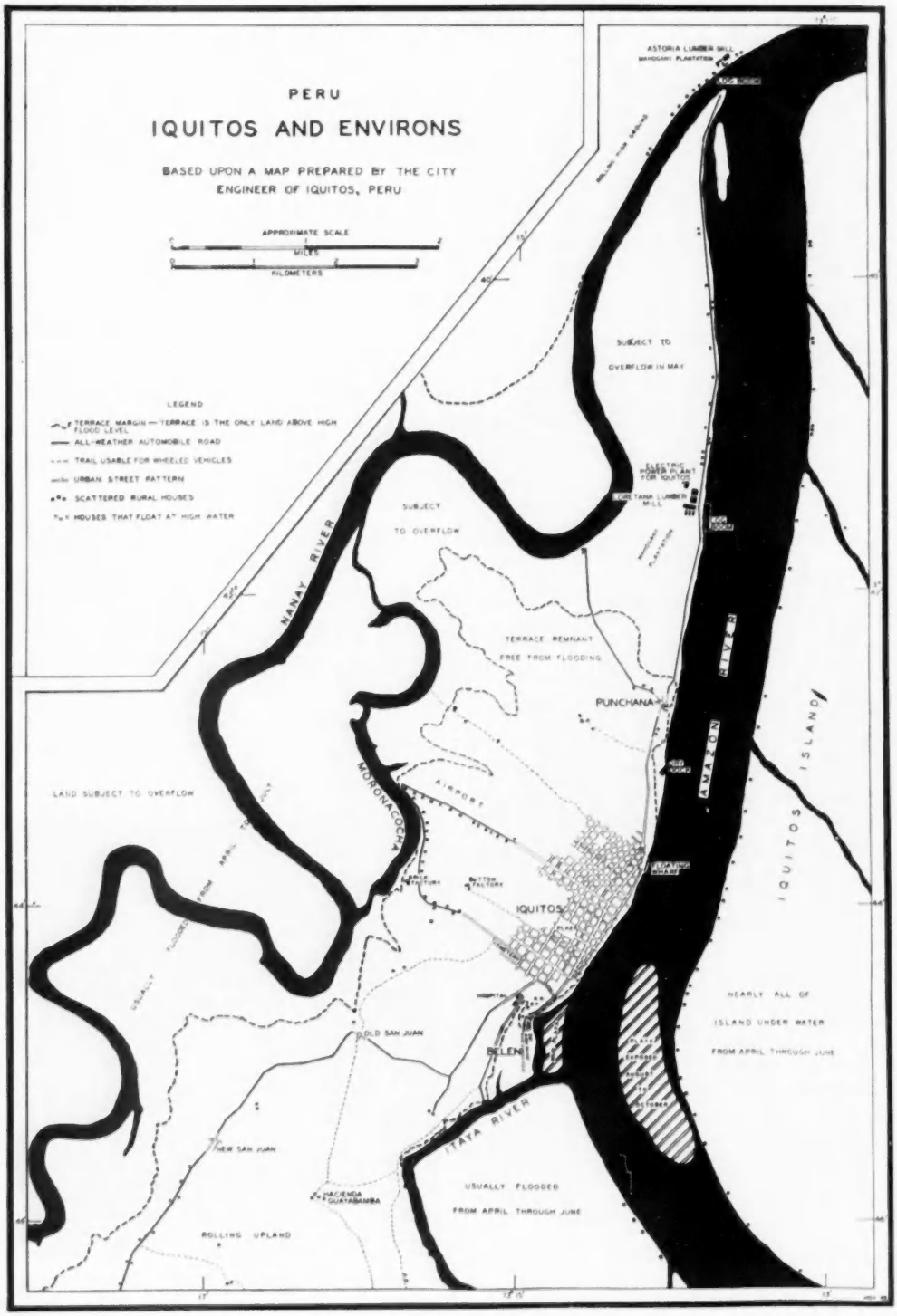

FIGURE 4.—Iquitos and surrounding territory. The latitude, longitude, and scale are approximate.

region is a part of the watershed of the Río Madeira and is tributary to Brazil. The population is sparse, the largest agglomeration, Puerto Maldonado, has only 600 people and the entire Department slightly more than 5,000, nearly all of whom are Indians only partially aware of political boundaries. Here the only use of mahogany is for firewood and local construction.

METHODS OF EXPLOITATION

There is a distinct division of labor between the production of logs and the production of lumber. The logs coming to Iquitos are usually cut by independent loggers and offered for sale when they reach the city. Although there is no open competitive bidding for the log

FIGURE 5.—The Compania Maderera Loretana lumber mill and storage sheds. Some of the logs in the boom have come to rest on the bank since the river level has dropped about eight feet below the high point reached on May 19. The picture was taken July 6, 1943. View slightly upstream toward the southwest.

rafts at that time, the operator, unless bound by contract, sells to the mill of his choice. If he is dissatisfied with the classification or measurement of his logs he may float his next raft to the other mill. Recently, because of the shortage of logs the mills have been offering contracts to the producers. The logger receives financial aid from the mill company, the company can expect

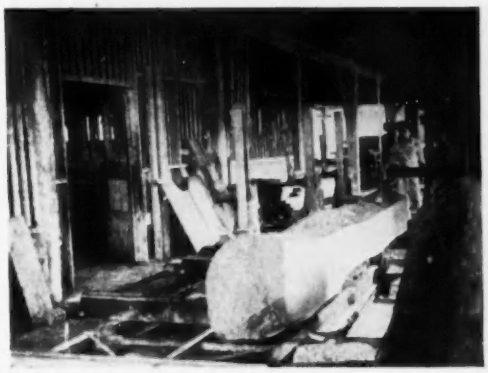

FIGURE 6.—The first cuts being made along one side of a cedar log at Loretana. The log is ready for turning and slabs will be taken from four sides.

his seasons' cut to be delivered to it. This practice benefits the saw mill in that a more certain log supply may be assured through controls they have on the borrower. The logger is benefited by the capital he has available to begin operations, but such a system often keeps him in debt and obligated to the lender.

Although some mahogany is cut during every month, there is a definite cutting season. This usually begins during the less rainy period in August or September. The logger buys the right to cut mahogany, either from the

FIGURE 7.—Three stages in handling mahogany lumber. Lumber lying in the foreground has just been sawed. In the middle ground lumber is stood on end to dry two weeks, in the background the dried lumber is stacked horizontally to season with small blocks of wood between the boards.

holder of a land title, or from the Government Forest Service if on public lands. Only the logger and his crew of men may operate in the area arranged for. One of the crew, known as a "cruiser," surveys the area and locates the trees to be cut. He may do this from a tall tree but more commonly it is done by chopping a trail through the forest. This forest dweller has an uncanny sense of identification and can recognize a mahogany tree from as far as he can see it. A possible future development will be the location of the best stands of mahogany from the air as has been done with limited success in the case of rubber.

The axe men follow the cruiser. They clear an area around the tree, fell it, and cut a trail wide enough to roll the logs to the nearest stream. The tree is usually chopped and sawed from a platform eight to 12 feet high to avoid the buttressed base. The trunks are cut into lengths from eight to 20 feet long,

FIGURE 8.—Yurimaguas, the second largest city of the Peruvian montaña. Located on the left bank of the Río Huallaga. View toward the west.

depending upon their diameters and the nature of the terrain over which the log must be rolled. The logs may be rounded with axes so they may be rolled more easily. Each year the percentage of rounded logs increases as the loggers go farther inland.

It is the opinion of loggers that trees, because of sap conditions, should not be cut from five to seven days after new moon. It is believed that pinworm, the only serious pest in the industry, is certain to develop in logs cut during the dark of the moon. There is no scientific evidence that such is the case but cutting operations are usually suspended at this time. The weeks vacation thus provided may have something to do with perpetuating this practice.

The determining factors in choosing trees to be cut are size and soundness. Because unsound logs bring almost nothing at the mill, very few logs below first class are sent downstream. Most of the trees that are cut average about three feet in diameter at the sawing height, though logs as large as 96 inches in diameter have reached Iquitos. It is difficult to determine the trees' age because of the absence of annual rings, but mill operators estimate the 36 inch logs to be from 60 to 100 years old. Trees grow most rapidly during their early life; in a fast growing area the minimum sized tree that may be legally cut (18 inches) might be only 20 years old. The very large trees are usually avoided because if they are overmature the heartwood is soft textured.

The Peruvian government has adopted a reforestation program which obliges the logger to replant two trees for every one he cuts. However, the Forestry Service find it very difficult to enforce this law.

During the cutting season each small group of men is essentially isolated in the forest (Figure 3). They are out of contact with their village homes so that all provisions and supplies must be carried with them or delivered at specified intervals during the several months of the logging season. After the start of the rainy season, but before

the small streams reach their crest, the logs are rolled by manpower to the stream banks to await the flood which will float them downstream to a collecting point where they will be made up into rafts for the trip to the mill.

TRANSPORTATION

Since there are no land routes of transportation in the "montaña," everything connected with the mahogany business moves by water. In an emergency a band saw blade or repair part may come by air, but the raw materials as well as the processed lumber constitute a one-way traffic down the river (Figure 4).

Single logs are collected downstream at a point convenient to the cutting area in the early part of the rainy season. Here they are made up into "balsas" or rafts for their trip to Iquitos. These rafts are formed by lashing together with vines ten or more logs side by side. Two such rafts are then securely fastened together end to end. Before the raft is finally sent on its way two or more units may be tied together to form a train-like procession. Such a master raft would contain from 40 to 100 logs and be from 25 to 40 feet wide and from 60 to 150 feet long. If the logs are fairly green, balsa wood or other light-weight logs, are made up in the raft to give buoyancy.

Temporary living quarters are set up on a roofed platform built at one end of the raft. Several men may cook, eat, and sleep on this raft for weeks. The largest rafts are pulled, or rather controlled by a tug whereas the smaller ones are manually guided. At times this requires vigorous paddling to clear the mud bars and to keep in the main channel. The trip from the Río Pachitea may take from four to six weeks. Log runs are timed to reach Iquitos at or shortly after the river starts to fall, from May to August, though small lots of logs arrive during the other months.

One of the reasons for the choice of the Iquitos area for mill sites by the two lumber companies was because of its strategic location. All major rivers of Peru, except the Napo and the two rivers that form the northern and eastern boundaries of the country, the Javari and Putumayo, join the Amazon at or above the city. Nearly all the mahogany cut on rivers emptying into the Amazon below the mouth of the Río Nanay goes to Manaus, Brazil as logs, as it is very difficult to tow a log raft upstream against the current. Occasionally a small raft is brought up from the mouth of the Napo River.

The mills are both downstream from Iquitos, close enough, however, to make use of the city's labor supply. The Compania Maderera Loretana, (Figure 5), managed by E. C. Drewry, an Englishman, is located three miles below Iquitos on the west or left bank of the Amazon. The Astoria Importing and Manufacturing Company mill managed by Edward Hartman, a North American, is seven miles below Iquitos on the left bank at the junction of the Nanay and Amazon rivers.

BUYING LOGS

When the rafts of logs arrive at Iquitos they are fastened with vines and cables to trees on the bank-side. Because of the swift current of the stream, it is necessary to store the logs upstream from the mills. Within a few days the rafts are cut apart and measured by employees of the mill. The logs at Loretana are inspected first by rolling the log, then by forcing one end and then the other out of the water by having three or four men climb on the opposite end. Later, logs are floated to a cable encircled boom to await sawing. Astoria has a wood-fired

steam derrick to lift the log out of the river for grading and measuring, then it dumps the log into a small pond from which it is pulled by cable car up to the mill.

Logs are graded by quality into first, second, and third classes, most of them being first class. The price of a log is based on the number of board feet, each first class log averaging somewhat over 700 feet.

After the logs have been graded, measured, and floated into the cable-enclosed log booms, nearly one year's supply of logs are on hand at the end of the high water season in June or July. These booms are attached to trees along the shore and must be constantly tended while the river is high in the event a cable should weaken. While the boom is being filled, all the logs are floating but as the river level drops, as much as 36 feet, most of the logs eventually come to rest on the river bank. As the sawing season progresses, the logs, one at a time, are rolled into the water and floated to the tracked carrier on which they are elevated to the mill by means of a cable and drum.

FIGURE 9.—Aguarana Indians living near the Río Marañón above the Pongo de Manseriche. These are characteristic of the native laborers in the less accessible parts of eastern Peru.

MILLING

Since the mills have not been established long, their equipment is fairly modern. The buildings are constructed of unplaned cedro lumber and roofed with corrugated iron (Figure 5). The sides are open to allow free circulation of air. Most of the sawing equipment is of American manufacture. All sawing of logs is done with band saws which save approximately one inch of lumber every five cuts. The lumber dimensions are full measure in that one inch boards plane down to one inch in thickness. Each mill has two or more saws, the largest one accommodates logs with diameters up to 72 inches. In addition to band saws both mills have other equipment for edging and planing lumber. The mahogany for export is not planed. Power for the Astoria mill is supplied by woodfired boilers which operate a reciprocating steam engine. All machinery is powered by belts from overhead shafts. Loretana is completely electrified with each machine powered by a separate motor.

Logs are first squared on the band saw and turned from time to time so that lumber is cut from all four sides (Figure 6). Because of this a variety of dimensions is obtained from each log. After the edges of the boards are squared they are sorted and stood on end to dry for two weeks (Figure 7). The lumber is then stacked with small blocks between each board to allow air circulation. It remains in these piles from a few days to two or more years depending upon the market and transportation; in recent years lack of transportation has been the critical factor. Lumber at Loretana is seasoned inside sheds, whereas Astoria stores nearly all its lumber out-of-doors.

The mills operate at capacity for only short periods of time. The potential annual capacity of the Astoria mill is about 5,000,000 board feet and the Loretana about 2,000,000 board feet,

but shortages of logs as well as technical and unskilled labor, and breakdowns usually reduce the output to less than one-half capacity. Iquitos exported 2,500,000 feet of mahogany in 1939.

MARKETING MAHOGANY

Nearly all of the mahogany lumber is exported from the country. Although cedro is shipped by way of the Amazon and Panama Canal from Iquitos to the Pacific Coast of Peru, both as logs and as lumber, no Peruvian mahogany ordinarily reaches Lima. The demand for mahogany there is supplied by imports of logs from Central America. Nearly all the Amazonian mahogany is marketed in the United States which normally imports from 80 to 90 per cent of the world's total cut. At the present time first grade mahogany is classed as a strategic war material and only consumers with top priorities may buy it. Most of it goes into boat and airplane construction, and pattern making. In peace times the furniture trade, fabricators of decorative interior woodwork, and boat builders buy the major part of the supply.

Peruvian mahogany lumber is held in high esteem by boat builders and the furniture trade. The wood is straight-grained and runs very uniform as to texture, principally because the lumber is manufactured in the tropics and all the soft textured wood in the heart of overmature trees is eliminated from the grades that come to the United States. As a result of tests conducted in the laboratories of Cornell University, Peruvian mahogany was found to increase and lose weight by absorption and shrinkage by an amount only slightly greater than that of Cuban or Spanish mahogany. The other mahoganies tested, swelled and shrunk from three-tenths of one per cent to five and eight-tenths per cent more. In tests of bending, compression and shearing strength, Peruvian mahogany excelled all others, but in hardness it was surpassed by Cuban mahogany.

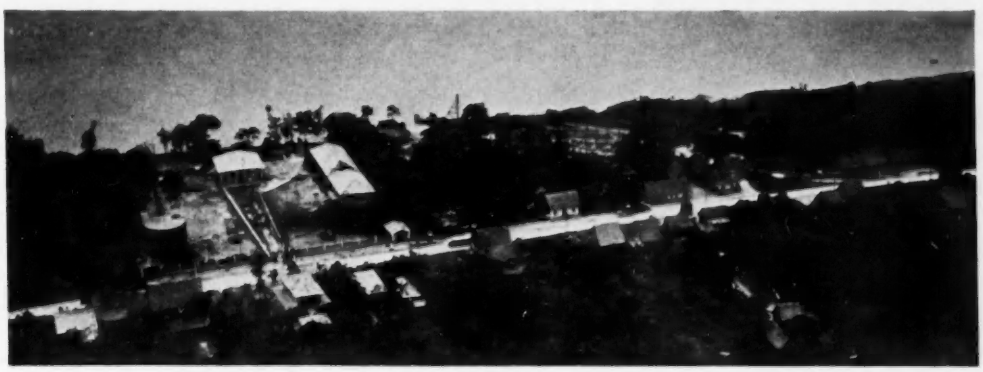

FIGURE 10.—Road between Iquitos and Punchana. Naval oil storage tanks and the partially completed dry-dock are located between the road and the river. View toward the east-southeast.

Although the market for mahogany was undersupplied in 1943, the Astoria mill had over 3,000,000 board feet of clear, first grade mahogany stacked about the mill because of a shortage of shipping space. No ocean-going freighters had called at Iquitos in nearly a year.

LABOR SUPPLY

In common with other commercial enterprises of the Amazon, the mahogany industry must compete in a deficient labor market. Even though the war-

time demand for mahogany greatly advanced the price of lumber, neither mill has increased production, one of them actually produced less in 1943 than 1942 because of a shortage of logs, breakdowns, inability to replace worn-out equipment and difficulty in maintaining a full crew of labor.

The well conducted census of 1940 counted 181,341 people in the Department of Loreto and estimated that 140,000 more lived in the forests and along smaller rivers where no accurate census was made. Most of the counted people live along the banks of the Amazon, Ucayali, Huallaga, and Marañón rivers (Figure 8).

This obviously limited supply of labor produces the rubber, leche caspi, balata and other gums, barbasco, cotton, coffee, tagua nuts, various fruits, medicinal plants, vegetable oils, plant fibers, and hides and skins of the "montaña." Moreover, due to the primitive organization of the region, it is necessary that most families produce much of their food supply. This is done by collecting, hunting, and fishing, and the cropping of small clearings which requires more man-hours to provide the daily needs of the family than would be required by specialized agriculturalists.

Very little of the potential supplies of labor in the towns such as Iquitos (34,231) or Yurimaguas (5,000) is available to employers in the up-river areas of the "montaña" because of actual and fancied dangers to life there (Figure 9). The higher pay that is now offered for work in the forest is countered by higher wages in the towns. Before 1941 the usual rate of pay for unskilled labor was about $.32 a day but by late 1943 this had risen to $1.00 or $1.50 (Figures 10 and 11).

A contributing cause to the shortage of labor is the poor health of the average worker which in turn is partly due to an inadequate diet. The only foods that are always available are "yuca" (mandioca) and "platanos" (cooking bananas). Both of these are high in starches and low in the fortifying food elements. Nevertheless many urban dwellers, and even rural people as well, eat nothing else for considerable periods of time. When this diet is enriched, or varied, it is usually done by supplementing it with rice and farinha (yuca flour). Meat is scarce and too expensive for many urban families, their meat supply is derived from monkeys and birds shot in the forest and fish caught in the rivers.

Because of an inadequate diet and the prevalence of infections, a very large proportion of the population suffers more or less constantly with intestinal parasites and skin infections. In addition, certain regions are notorious for their high incidence of malaria, beri-beri, leprosy, and yellow fever: the latter has been nearly eliminated. Other disorders such as grippe or influenza, dysentery and a neuralgic condition may strike large numbers at any time in any area. The people of Iquitos enjoy a state of health probably better than the people in most of the smaller towns and scattered rural areas. This is not due to a safe water supply nor to an adequate sewerage disposal system. To date Iquitos has neither, although projects to provide these are partially completed.

The wages of workers in the mills, even though they have increased, have not kept up with the higher costs of living. It was claimed that by August 1943, even though wages had more than doubled, the cost of food had quadrupled. Food accounts for a large part of the budget of a family whose income is less than one dollar a day.

One-half or more of the laborers at the mills live on small plots of ground within a short distance of the mill where

FIGURE 11.—Airport at Quitos. The landing field was extended in 1944 across the road and off the left side of the picture. Moronacocha along right margin. View toward southeast.

they may supplement their wages by producing a part of their own food (Figure 12). Fifteen or 20 employees of Astoria live in Iquitos and travel to and from work on a company boat.

USES

Due to mahogany's color, grain, and hardness, it has long been a premier cabinet wood. However its ease of working, its strength, and its adaptability for veneers have added greatly to its utility.

In the regions where mahogany grows it does not hold a high place. Its weight and hardness are handicaps which favor the use of lighter and softer woods for construction; and where a highly finished article is desired other woods such as "palo de sangre" (rosewood) are harder, and have a richer color.

Peruvian mahogany is golden-brown when dry, but when freshly cut it has a yellowish to salmon pink color. Its appearance is totally unlike the artificially dark red finish typical of mahogany furniture of the last century. Since Peru exports no logs and there is no cutting of veneer in Iquitos, all Amazonian mahogany from Peru used in the U.S.A. is lumber and not veneer. The principal demand at present is for straight-grain mahogany lumber for use in naval and aircraft construction (PT boats, propellors). Such lumber comes only from straight clear logs. Here mahogany's advantage is not in its beauty but in its strength vs. bulk, and its resistance to swell, shrink, and warp. Although only grade one select mahogany is permitted to come into the United States from the Amazon for use in construction of boats, airplanes, model and pattern making, instruments and instrument cases, the second grade common lumber will be used to good advantage by furniture

manufacturers when shipping space is again available.

The reason for mahogany's wartime demand is based upon (1) its high ratio of strength to weight, (2) its resistance to moisture and atmospheric changes causes it to warp, shrink, swell and twist less than any other commonly used lumber, (3) great size of the tree which may yield unusually large clear pieces, (4) large proportion of logs are straight grained, (5) its uniformity due to absence of alternate rings of dense and less dense wood lends itself to ease of turning, gluing and other manufacturing processes, (6) mahogany is resistant to rot, mould, and other organisms of decay. It is particularly adaptable for use in the tropics where termites and other organisms quickly destroy many other woods, (7) it dries quickly and without waste in kilns, (8) takes and holds finishes well.

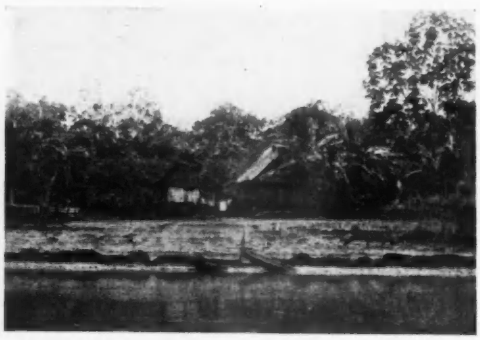

FIGURE 12.—Homes of two mill laborers to the north of Loretana. This area is flooded several weeks each year necessitating homes on poles or balsawood rafts to keep dry.

The postwar demand for mahogany for furniture and woodwork will be due to the above qualities plus the decorative effect of the figure and grain of parts of the tree now unused.

SUBSIDIARY CONSIDERATIONS

An industry which originated as a by-product of the lumber mill at Loretana is the electric power plant for the city of Iquitos. The power plant was originally fired with scrap and waste from the mill but further enlargement has so increased its requirements for fuel that the mill furnishes only a minor part now. The power plant is, however, conveniently located to its present main source of wood. The Río Nanay approaches within 200 yards of the Amazon so that a narrow gauge track has been built from the power plant to the Nanay. The labor supply for wood cutting on the Río Nanay has been so uncertain that postwar plans call for installation of oil burning equipment in spite of the wealth of wood in the immediate vicinity. In 1943 there was rarely more than three or four days supply on hand at any time.

In addition to mahogany both mills cut large quantities of "cedro" or Spanish cedar. This is the most widely used constructional lumber in eastern Peru. It is a curious fact that practically no mahogany is shipped to western Peru but nearly all the cedar is.

The Astoria Importing and Manufacturing Company, as its name implies, has an interest in eastern Peru beyond the cutting of lumber. Besides contracting for logs and advancing money for them, the company is interested in the promotion of a number of other Amazonian products. Among these are Hevea and caucho rubber, barbasco, cinchona bark, a palm nut resembling the Brazilian babassú, tagua nuts, leche caspi, balata, and various skins.

The mahogany plantation at Loretana has 7,000 trees from four to 11 years old (Figure 13). Astoria has approximately the same number planted at a later date. So far no disease has manifested itself among these closely spaced mahogany trees. In their widely scattered locations in the forest the trees have few biological enemies but in the

FIGURE 13.—A view of the mahogany plantation at Loretana. These trees are seven years old. The land is kept clear for the first years by raising food crops. Thereafter the only attention given is the chopping out of undergrowth once or twice a year.

close contact of a plantation blights and other enemies might be expected to appear.

FUTURE

Although the mahogany industry of Peru is a relatively new one, the easily available logs of the most accessible rivers have already been exploited. In the future, loggers will have to go farther from the streams and operate on minor water bodies. Up to the present and for some time into the future, if shortages hinder lumber production it will likely be due to a shortage of labor in the cutting areas.

Because of the favorable growing conditions on the Amazon and the scattered occurrence of mahogany, young trees are ordinarily not disturbed when an area is worked over, in this way mature mahogany trees from previously exploited areas might be cut every ten or twenty years.

It is the opinion of some that the greatest hope for the future of mahogany in Peru lies in the enlargement of plantations such as those started by the two lumber mills, where from ten to fifteen thousand trees are now growing. These trees have grown to heights of 25 feet in ten years and should reach maturity in about 40 years. If the mills are then operating at approximately the same capacity as now, the area already planted might provide a three to a six year supply of logs.

JAPAN'S OIL RESOURCES

Muzaffer Erselçuk

(Written before Japan's unconditional surrender)

JAPAN'S oil supply problem may well develop into her heel of Achilles, for certainly it has become one of her most vulnerable spots with the American victory on Okinawa and Chinese successes on the continent. These gains spell disaster to shipping lanes from the Japanese homeland to the rich oil fields which she has conquered in Southeastern Asia and will throw her back upon her own oil resources in the so-called "Inner Defense Zone," comprised of Japan Proper, Karafuto, Korea, Formosa, Manchuria, and North China.

What are her chances of eking out oil supplies for her armies and industries from these resources? The following article attempts to answer this question.

Japan Proper

Although Japan Proper is generally regarded as being very poor in petroleum resources, this common supposition is not quite valid today because detailed geological investigations and development of new oil prospecting methods have greatly enhanced the known reserves of every oil-producing country, Japan included.

Almost all of the known oil fields of Japan Proper are in the Miocene and Pliocene series of the upper Tertiary. The oil-bearing strata consist of sandstone, tuff, and shale; and the large oil accumulations are found on anticlinal, domal, or terrace structures. The principal oil-yielding belts extend on the northwestern side of Honshu and western side of Hokkaido, almost parallel to the Sea of Japan. Outside this belt, certain parts of central Honshu and eastern Hokkaido have geological conditions which are suitable for the presence of oil, although not in large quantities.

There are four producing regions. Three of these, Totomi, Echigo, and Akita are in Honshu, and the other, Ishikari, is in Hokkaido (Figure 1). Each region is composed of numerous fields, some of them developed, others yet to be discovered. The largest producing regions are located in the Echigo and Akita regions (Table 1). Oil-bearing strata in Echigo are known to be about 10,000 feet thick; the Akita fields, on the other hand, have thinner oil-bearing strata, but they are known for gushers, several of which yielded 10-12,000 barrels a day when the wells were first drilled. But the gas pressure soon decreases, and after a flow of several months the wells generally have to be pumped out. The well which hit oil on June 2, 1944, is probably such a gusher. The Japanese claimed that this well was the largest producer in Japan, despite the fact that muddy water forms about half of the output. Discovery of a number of gusher wells since 1935 has made Akita the largest producing region in Japan.

Until recently the developed wells were almost all on the anticlinal ridges because of the relative ease in determining geological structure and since there is no surface guide to the structure of the subsoil on the plains that lie between the hills. The adoption of various geophysical oil exploration methods, such as gravimetric and seismic surveys, however, have enabled the Japanese during the past decade to study the areas with inadequate geological ex-

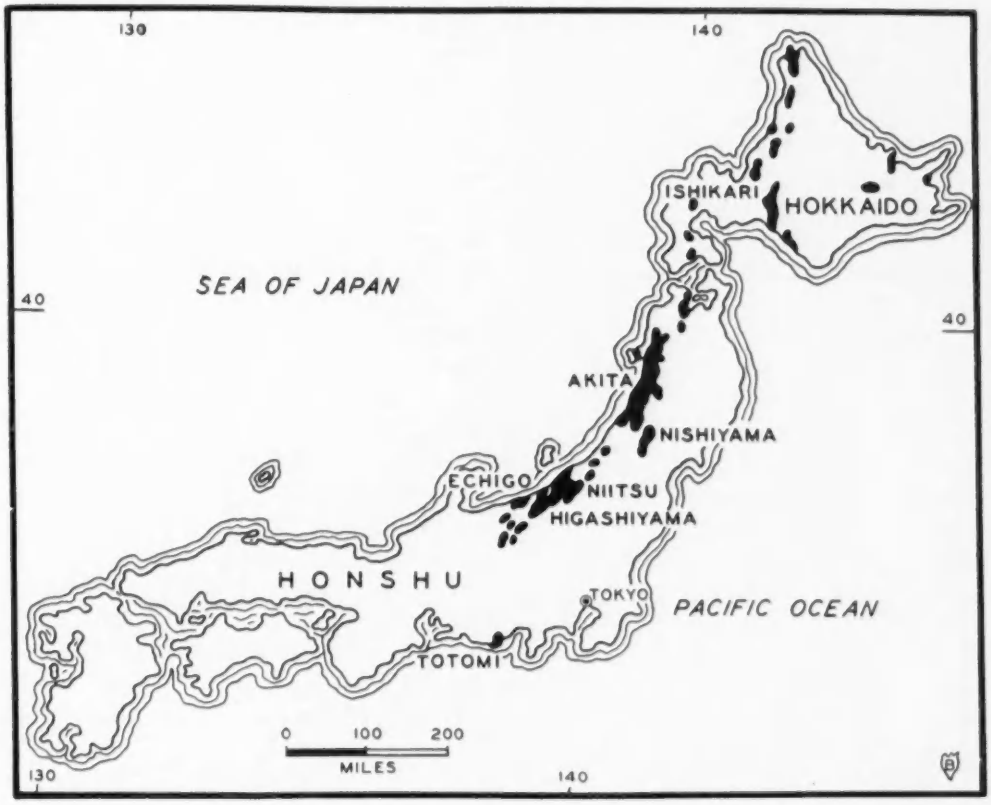

FIGURE 1.—Oil Fields on the Home Islands of Japan.

posure and as a result new fields have been discovered.

In contrast to the American oil wells, which are getting deeper, most of those in Japan are very shallow. The average depth of more than half of the wells is less than 1,500 feet, and there are only a very few wells which go deeper than 5,000 feet. Since the new wells with a depth of 1,500–2,000 feet are producing appreciable quantities of oil, it appears that the shallow fields are not yet exhausted.

On the whole, the Japanese crude oils are fairly poor in quality because they are for the most part heavy oils deficient in gasoline. Generally speaking, crudes high in gasoline content come from deeper wells. Petroleum from Hokkaido and from part of the Akita fields yield a higher gasoline content (25–40 per cent), whereas those from Echigo and from part of Akita are viscous and yield little or no gasoline. They do, however, supply higher lubricating oils.

No estimate of the petroleum reserves of Japan made by a Japanese expert is available in the Western countries; in fact, no such estimate is known to be published in Japanese for general use. There is no doubt, however, that confidential estimates exist in the files of the Japanese government. Estimates of the oil reserves made in the Western countries greatly vary and at best are highly speculative, since any oil estimate based on inadequate data could not be otherwise. Nevertheless a few of them are as follows:

Morgan Clements	390–1,090,000,000 barrels
David White	1,000–1,400,000,000 barrels
W. B. Heroy	500,000,000 barrels

All of the above estimates were fairly reliable computations on the basis of data available at the time they were made. But these data were not complete, simply because most of the oil-bearing regions were not properly investigated prior to the China Incident, and as a result the area of the oil-bearing lands was not accurately known. The Cabinet Planning Board's figure on the oil-bearing land area was about five billion tsubo (4,085 million acres), whereas some of the Japanese oil experts believed that oil lands covered ten billion tsubo (8,170 million acres). A study of the Imperial Geological Survey maps with their "Explanatory Text(s) of the Oil Fields of the Japanese Empire" until 1937 (none available since) and of various articles in Japanese periodicals indicate that the total investigated area of the oil lands is about four million acres. The Cabinet Planning Board's figure therefore appears to cover only the known fields while the estimate proposed by the experts covers all of the possible oil-bearing area, studied or unstudied by the Geological Survey.

On the basis of published descriptions and maps which are available, the oil reserves recoverable by present methods in Japan Proper may be estimated at between 1,850–2,220 million barrels.

Interest in the Japanese oil potentialities rose rapidly as dark clouds began to appear in the international scene during the early thirties. As a means of increasing domestic petroleum production, the government decided to grant a subsidy of 4,500,000 yen for oil well drilling for the five-year period beginning in 1936. During the same year the Japanese Diet recommended an oil-land survey, which was begun in the following year by three groups of geologists. The China Incident of July, 1937, resulted in the necessity for governmental control of liquid fuel production, trade, and consumption; and the legal basis for state intervention in the oil industry was prepared when the Diet passed the "Imperial Fuel Development Law" in August, 1937, and the "Petroleum Resources Exploitation Law" in March, 1938. The latter law provided for government supervision and control of drilling operations, compulsory coöperation between owners of mining rights, and larger government subsidies for drilling. A five-year plan, extending over the fiscal years 1938–39—1942–43, was devised to increase domestic production; and prospecting was to be undertaken for 330 new wells, aided by an appropriation of eighteen million yen which was to be utilized during the five-year period. Although no figures were made public as to the ultimate goal of the plan, a new plan adopted in January, 1939, to replace the former plan aimed at increasing the gasoline production by 30 per cent and heavy oils production by 40 per cent between the 1938–39 and 1942–43 fiscal years. In other words, assuming that the 1938–39 production of crude petroleum was about 2,800,000 barrels, the production anticipated for 1942–43 becomes roughly 3,800,000 barrels.

About the actual results of these plans no reliable data are available. The progress during the 1936–38 period seems to have been slower than was expected, if one is to judge by the amount of subsidies paid for prospecting. According to the Japan-Manchukuo Year Book, 1940, p. 366, the following sums were paid as subsidies for oil prospecting:

1936	232,000 yen
1937	386,000 yen
1938	692,000 yen

After the 1942 conquest of the rich oil fields in the East Indies and Burma, the development of domestic fields was

retarded. Machinery and drilling equipment, as well as experts, were sent to the newly acquired territory in large numbers. Soon realizing, however, the approaching danger to their supply lines between Southeastern Asia and Japan, the government revived the old program of increasing domestic production, and some success was achieved in 1944 and 1945 in locating new reserves in the Niitsu and Akita fields. The present rate of production is probably around 4,000,000 barrels a year (Table I).

deposits; however, the fact that they are largely closely folded would discount hopes of finding large reserves. Oil-bearing strata are found near Konotoro, 35 miles west of Ochiai, at Maruyama, near Ochiai, and in many other places. The Maruyama area was considered most promising and in 1934 wells were being drilled by the Japan Petroleum Company. However, no productive oil field, either at Maruyama or in any other part of Karafuto, was discovered until 1939.

TABLE I

CRUDE OIL PRODUCTION IN JAPAN PROPER

(In thousand barrels)

Year	*Akita*	*Echigo*	*Hokkaido and Others*	*Total*	*U. S. Bureau of Mines Estimate*
1932	564.2	926.1	106.5	1,578.8	.....
1933	529.9	798.4	92.5	1,420.8	.....
1934	964.7	732.3	91.0	1,788.0	.....
1935	1,457.5	668.4	84.8	2,210.7	.....
1936	1,799.9	585.0	76.3	2,461.2	.....
1937	2,000.0e	600.0	90.0e	2,690.0e	2,488b
1938	.....	.....	.....	2,800.0e	2,511b
1939	.....	.....	.....	.....	2,654b
1940	.....	.....	.....	.....	2,639b
1941	.....	.....	.....	3,300.0a	2,659b
1942	.....	.....	.....	3,400.0a	.....
1943	.....	.....	.....	3,500.0b	3,500b
1944	.....	.....	.....	3,700.0e	.....

Sources: The figures for 1932–1936 are compiled from data given by the following Japanese Commerce and Industry Ministry publications:

(1) *Situation of Japanese Mining Industry* (Hompo Kogyo no Susei).

(2) *Statistical Year Book of the Ministry of Commerce and Industry* (Shoko Tokeihyo).

Symbols: a—Estimate from *AIME, Transactions*, Vol. 15, p. 262.

b—Estimates of the United States Bureau of Mines. Production estimates of crude oil for the years 1937–1941, obviously of the same origin, given by the Bureau of Mines, the *Statistical Year Book of the League of Nations*, and many others, appear to be somewhat low in the light of fragmentary data available today.

e—Estimates of the writer.

KARAFUTO

The oil-bearing structure extends northward from Honshu and Hokkaido to cover the island of Sakhalin, of which the southern half, called Karafuto, belongs to the Japanese. An oil-bearing area was discovered in 1907 at a point on the southwestern coast of the island, and active prospecting has been going on since 1918.

The areas of Tertiary rocks are large enough to contain commercial size

FORMOSA

Crude oils of good quality and fairly high in gasoline content are obtained from the Taihoku fields of northern Formosa. In nature and in geologic origin they resemble the Hokkaido crudes fairly closely. As in Hokkaido, the production has in the past been very small, but the results of recent explorations are not known. If true, a 1940 report of the discovery of a "rich oil field" at Chikutozaki in Tainan pre-

fecture, southwest Formosa, indicates that the oil-bearing zone is not confined to the northern part of the island. However, the fact that earthquakes cause frequent traverse dislocations accompanied by horizontal displacements would make the presence of any large oil pools highly doubtful. This conclusion is reaffirmed by a study of tectonic relations of the oil-bearing basins to the bordering tablelands.

The production of crude oil was gradually increasing even before the China Incident. The production of crude oil in Formosa from 1932–36 was:

1932	32,800 barrels
1933	36,500 barrels
1934	35,100 barrels
1935	41,800 barrels
1936	45,500 barrels

The production for 1936 was given by official Japanese sources as the equivalent of 45,500 barrels, valued at 312,000 yen. The output should have increased since that time, since in 1937–38 alone the administration of Formosa appropriated 1,005,000 yen for subsidies to oil producers and prospectors. The crude oil production of the island is now possibly around 50,000 barrels yearly, excluding gasoline obtained from natural gas.

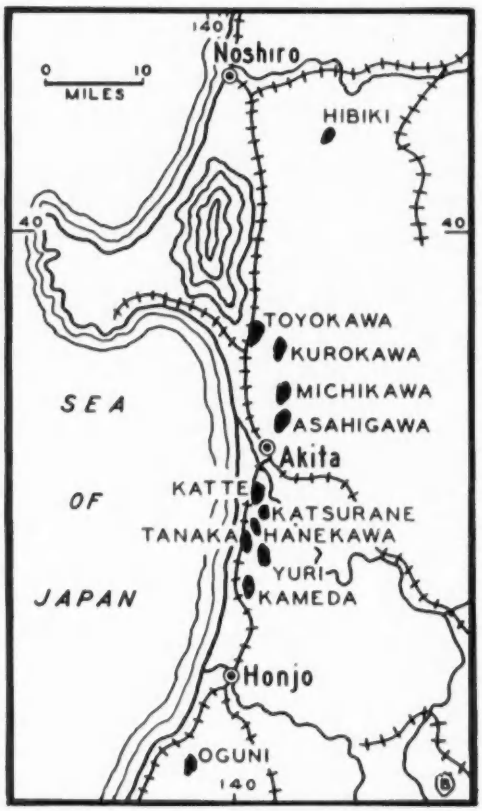

FIGURE 2.—Oil Fields in the Akita Oil Region. This region is the most productive in Japan Proper. Before Pearl Harbor, about 100 new wells were drilled every year.

KOREA

Korea is composed almost entirely of crystalline and metamorphic rocks. A large part of it has been thoroughly explored, and there is very little possibility of its becoming an oil-producing area. In spite of this unfavorable geologic situation, a Russian source reported in 1936 that a special company had been carrying on investigations during the previous year.

MANCHURIA

While southeastern Manchuria is geologically similar to Korea and the Shantung peninsula, basins of younger rocks occur in western Manchuria in association with coal and oil shale. Conditions for the accumulation of oil are said to be quite favorable in these areas, since the presence of oil shale and coal deposits with "low carbon ratios" suggest that regional metamorphism is low. Detailed geologic investigations accompanied by drilling during 1939–41 have resulted in three productive oil fields.

Test borings at Chalainor in northwestern Manchuria, near the Russian border, showed the presence of oil in 1939 and 1940. According to a report in the Yomiuri, the Japanese were making preparations to start "large scale drip drilling."

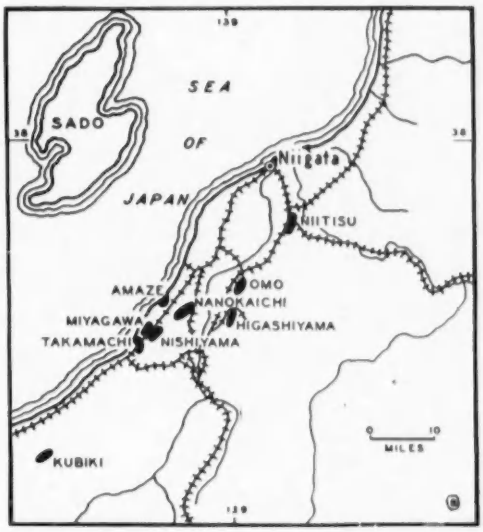

FIGURE 3.—Oil Fields in the Echigo Region. This is the second largest producing region in Japan. Its importance has been increasing with the drilling of new wells at Omo and Niitsu.

In April, 1940, oil was discovered at Fuhsin in southwest Manchuria, where a 36-foot oil layer was reached at a depth of 350 feet by the Number-1 well. Further investigations disclosed the presence of "four oil-bearing strata running 100 kilometers (62 miles) east to west." It was further intimated that other oil strata might exist at greater depths, perhaps as low as several thousand feet. Boring for the Number-2 well disclosed the existence of a fifth oil stratum at a depth of "a few hundred meters." According to reports, considerable oil has been taken out of the first well.

A third field was located early in 1941 near Pancheng, 15 miles east of Chengteh, Jehol, and near the Chinchow-Kupeikow railway. This field, called the Tiarkou field, is said to be similar in structure and oil wealth to the field at Fuhsin.

Although Taketora Ogata, president of the Japanese Information Board, said early in 1944 that the petroleum reserves of Manchuria were about five billion metric tons (35 billion barrels), this figure seems very large. A crude and perhaps optimistic estimate of the writer, based on descriptions of the three known fields, puts it at about five billion barrels. The derivation of any reliable estimate is rendered impossible by the extreme secrecy maintained by the Japanese.

In addition to the petroleum reserves, a great deal of oil is extracted from Manchuria's oil shale. Although oil shale reserves exist in many parts of the Japanese-occupied lands, only those in Manchuria have commercial possibilities at the present time.

Oil shale, which has been reported in numerous places in Manchuria, lies within a semi-circular zone between the northeastern and southwestern corners of the country. The total reserves of the known deposits in 1939 were estimated at 7,600,000,000 metric tons. Since this estimate was made several large deposits were discovered in Chilin (Kirin) and Jehol.

TABLE II

IMPORTANT SHALE DEPOSITS

Deposit	*Location*	*Reserve*	*Oil Content Per Cent*
Fushun	Central Fengtien	5,900,000,000	5–5 (average)
Fengning	West Jehol	16,000,000	4–7
Weichang	North Jehol	very large	...
Chiufutang	Southwest Jehol	12,000,000	3–7
Lotzukou	North Chientao	200,000,000	4–6
Kunglantou	Southeast Chilin	...	4–7
Sanhsing	South Sankiang	...	...

FIGURE 4.—Mount Fuji, where Japanese tried to find oil. Drilling activities were carried on in 1939–40 on the sloped of Mount Fuji, with no success.

As is seen from the table, the largest known oil shale deposit is at Fushun, lying immediately above the famous Fushun coal deposit. The shale is 450 feet deep in the thickest part; and its oil content ranges from 10 to 12 per cent in the upper part of the seam to one to three per cent in the lower part, averaging 5.5 per cent for the deposit as a whole. This percentage is fairly low for commercial exploitation; however, since the shale must be removed in order to mine the coal by the open-pit method, this removal cost can be charged against the coal mining. Therefore, economic production of shale oil has been possible.

A pilot plant was built in 1924 to experiment in shale oil production in Manchuria, and with the experience thus gained, a commercial size factory was built in 1929. The production capacity of the plant was doubled in 1935, from 500,000 barrels to about 1,000,000 barrels, and it was increased again in 1938, becoming about 2,500,000 barrels. After the adoption of numerous expansion plans during 1937–39, it was finally decided to raise the capacity to 7,000,000 barrels by 1944. The original Five Year Plan of 1937 provided for the expansion of shale oil production capacity to 5,600,000 barrels by 1942, but the first revision of the plan in 1938 reduced this goal to 4,550,000 barrels. In March, 1939, the directors of the South Manchuria Railroad Company voted to raise the capacity to 3,500,000 barrels in 1941. Their plan contemplated a further increase to 5,250,000 barrels in 1942 and to 7,000,000 barrels by 1944, at a cost of 150,000,000 yen. The present capacity is not known, but it is logical to assume that the capacity has probably reached the planned figure as a result of the motivation caused by greater needs for oil.

The production of crude oil from shale has rapidly increased from 469,000 barrels in 1935 to 861,000 in 1936 and to 966,000 in 1937. This 1937 amount of crude oil when refined yielded the following products: 490,000 barrels of fuel oil, 49,000 barrels of gasoline, 7,000 metric tons of paraffin, and 8,000 metric tons of coke. Although no production

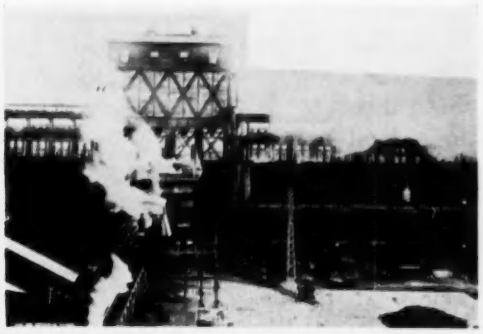

FIGURE 5.—Low Temperature Carbonization Plant near Tokyo. Japan's lack of sufficient petroleum to fill her needs forces her to manufacture much of her requirements from coal by synthetic means.

figures are given since 1937, estimates for 1938 and 1939, computed from the balance sheets of the South Manchuria Railroad Company and re-ascertained from the shale-oil export figures from Manchuria, are 1,000,000 and 1,600,000 barrels of crude oil respectively. If the present production capacity can be taken as 7,000,000 barrels, the 1945 production, if not interrupted by air raids, may be as high as 5,000,000 barrels of crude oil.

JAPANESE-OCCUPIED NORTH CHINA

Petroleum-bearing areas are found in Japanese-occupied parts of North China at several places. During 1913–1915, most of these areas were visited by Messrs. Myron L. Fuller and Frederick G. Clapp, who were conducting geological investigations with a large staff on behalf of the Standard Oil Company. As a result of their explorations, the Shensi basin (outside Japanese domination) was found to be the only promising area in North China.

Since their occupation of North China, the Japanese have made a number of investigations for oil. The results of their earlier investigations appear to agree with the findings of the Fuller-Clapp expedition. Since the oil-bearing area in Shensi was not under Japanese occupation, the later studies covered the area uninvestigated by the American geologists, and appear to have achieved some success. The available knowledge on the North China oil resources may be summarized as follows:

It is highly improbable that Shantung Province, a region composed mostly of old rocks, has any oil-bearing area. Hopei and Honan provinces may have some oil in scattered places, but not in commercial quantities. The oil zone in Shansi is limited to a narrow section along the western margin of the province. Structural indications which might guide drilling are few, oil pools are probably small, and prolific production is most unlikely. Furthermore, this area is handicapped by the lack of transportation facilities. The Mongolian steppe region, nominally under the rule of the Mengchiang puppet government, is reported to be promising in the light of recent investigations. A number of wells are understood to have been

FIGURE 6.—Oil Storage Facilities at Fuhsin. Oil was discovered at Fuhsin in April, 1940. This picture, taken in early 1941, indicates that considerable installations were built without delay.

drilled during the past few years in this area, but results are unknown.

On the whole, Japanese-occupied North China is not a promising area for immediate oil production.

CONCLUSION

The natural oil reserves of the "Inner Defense Zone" although fairly large, are

FIGURE 7.—Mining Oil Shale at Fushun. The shale, lying above the coal deposit, is removed by mechanical devices. As is noted from the picture, a part of the equipment is American made.

thinly scattered; and no sizable pools are found. This fact makes exploitation difficult and uneconomical. New oil fields are brought into production only after numerous unproductive test drillings have been made. The prospects for a rapid increase in oil production, therefore, appear to be unlikely.

Japan's current wartime consumption of oil products is estimated at about 55,000,000 barrels. She produces about one-sixth of this amount in the Inner Zone from natural oil and oil shale. The remaining five-sixths of her needs have to be supplied from synthetic oil obtained from coal, from substitute fuels such as pine oil and alcohol, and from natural oil imported from the southern regions under hazardous transportation conditions.

Although the sea route from Japan to the East Indies is almost cut by the American navy and air force, the land route through China is still open; and limited oil supplies are flowing northward by means of rail and truck transportation. Assuming that the Japanese have not laid a pipeline from the Sumatra oil fields to the railroad terminals in South China, since it is unlikely that they could have accomplished its construction because of lack of technical knowledge and iron and steel, the oil that could be carried by other means would be extremely limited.

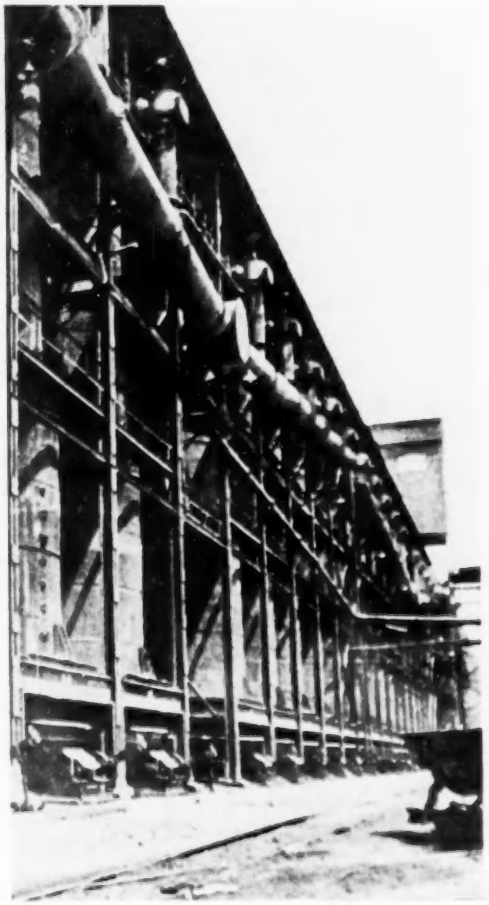

FIGURE 8.—Oil Shale Refinery at Fushun. This plant reputedly produces as much oil as all oil wells in Japan Proper put together. Its huge size makes it an extremely vulnerable target for American planes.

All of these factors, however, do not mean that the Japanese are desperate for oil. It is a well-known fact that crude oil as well as gasoline and lubricating oil have been stockpiled in Japan Proper for the past fifteen years, and experts believe that these stocks alone are sufficient to cover 12 to 18 months' needs at the present rate of operations.

CHEESE REGION OF NORTHWESTERN ILLINOIS

Loyal Durand, Jr.

ILLINOIS follows Wisconsin in cheese production in the United States. While other states have more dairy cattle, produce more milk, and manufacture more butter, Illinois follows the leading dairy state both in production of American Cheese and Swiss Cheese, the two leading varieties manufactured in the country. Illinois is third in total number of cheese factories (Wisconsin 1817, New York 166, Illinois 113 in 1939), second in production of American Cheese (Wisconsin 284,044,472 pounds in 1939, Illinois 29,346,287), second in production of Swiss Cheese (Wisconsin 28,637,587 pounds in 1939, Illinois 5,227,879 pounds), and second in production of brick cheese (Wisconsin 24,648,825 pounds in 1939, Illinois 1,923,446) (Table I).

TABLE I

CHEESE PRODUCTION—UNITED STATES

Year	*American (lbs.)*	*Swiss (lbs.)*	*Brick and Munster (lbs.)*
1937	492,041,000	41,504,000	35,643,000
1938	560,542,000	43,084,000	34,995,000
1939	537,298,000	42,631,000	34,969,000
1940	602,790,000	48,659,000	34,328,000
1941	753,122,000	55,962,000	32,066,000
1942	916,850,000	51,240,000	28,798,000

Cheese production of the United States has increased markedly since the outbreak of the war in 1939. This has been particularly true of American cheese. Since the cheese output of the Stephenson County area of Northwestern Illinois is largely Swiss and brick cheese, the percentages as indicated in the accompanying article are basically the same as the 1939 figures. Preliminary figures indicate that the recent increase in both Wisconsin and Northwestern Illinois has been about the same.

THE DAIRY REGIONS OF ILLINOIS

The dairy regions of Illinois are primarily two in number. Each of the regions, viewed on a national scale, is an "overflow" from the main dairy region of Wisconsin. The northeastern part of Illinois, a triangle extending northwestward from the city of Chicago to the Wisconsin state line, is the great fluid milk producing section of the state. (See Loyal Durand, Jr., *The Dairy Region of Southeastern Wisconsin and Northeastern Illinois*, ECONOMIC GEOGRAPHY, Vol. 16, 1940, pages 416–428.) The second dairy region in Illinois is the northwestern corner of the state, located primarily in the two counties of Stephenson and Jo Daviess. Between the two dairy regions, along the Wisconsin border in north-central Illinois, in the Rock River Valley, there is an area of less intensive dairying, in effect an area which is a northward projection of the Corn Belt, but has an agriculture of a mixed Dairy-Corn Belt economy (Figure 1). Such dairying as is carried on in this north-central region is primarily for fluid milk for the city of Rockford, and also for the shipment of some milk to the Chicago market.

The dairy region of northwestern Illinois is a manufactural region. Milk from the farms is sold to crossroads cheese factories (Figure 2). It is in this region that practically all of the Illinois Swiss Cheese, all of the brick cheese, and a considerable share of the American Cheese is manufactured. The region is margined on the east by the bordering hills of the Rock River Valley, and economically is margined by the transitional zone between the fluid milk area and the cheese producing region, is bounded on the north by the Wisconsin-Illinois state line, on the west by the Mississippi River, and on the south by the transition to the Illinois Corn

Belt. The region is set apart in cultural elements of the landscape from northeastern Illinois dairy sections by the appearance of the crossroads cheese factory. This region of northwestern Illinois is in many ways an integral portion of the cheese manufacturing regions north of it in Wisconsin. The broad area in the two states is a single region, a single sub-unit of the American Dairy Belt, whether located in Wisconsin or Illinois. This sub-unit is in itself segmented by the Wisconsin-Illinois state line into a northern major portion, and a southern smaller portion, hugging the state line.

STATE AND REGIONAL FACTORS

The dairy region of northwestern Illinois is the outstanding cheese manufacturing section of the state. The statistics previously presented, viewed by the uninitiated, might imply that cheese manufacture in Illinois was a separate entity, something carried on somewhere within the confines of the state boundary. *Regionally* the actual

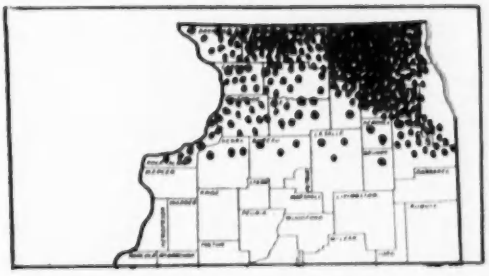

FIGURE 1.—Location of "Dairy Products Farms," as classified by the 1940 census, in northern Illinois. Each dot represents 25 farms. The fluid milk area northwest of Chicago and the Dairy Region of northwestern Illinois, centering in Stephenson County, are well shown. The area of lessened intensity between is the Rock River Valley. The third dairy region of Illinois—the St. Louis milkshed east of St. Louis, Missouri—is not shown, and lies south of the border of the map.

facts are quite different. The cheese manufactured in Illinois is practically all made in the northwestern corner of the state, is manufactured in a region which is adjacent and contiguous to southwestern Wisconsin, and in many ways its production is practically a part of the main Wisconsin regional production (Figure 2). Thus viewed, on a

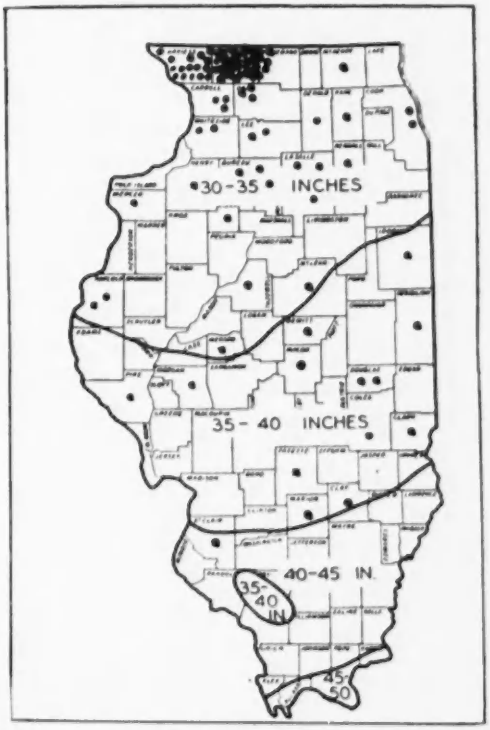

FIGURE 2.—The cheese factories of Illinois, 1944. Each dot represents one factory. Note the concentration in the northwestern portion of the state, particularly in Stephenson County. The scattered cheese factories of the Corn Belt portion of the state are largely of recent founding, while those of the dairy region of northwestern Illinois have been established for many years. The dots have been superimposed on the rainfall map of Illinois—the latter from University of Illinois, Agricultural Experiment Station, Bulletin 403, page 107.

regional rather than a statistical basis, the Illinois production, instead of becoming a poor second among the several American states, actually becomes part and parcel of the broad regional cheese production found in that portion of the American Dairy Belt west of Lake Michigan. If the even broader "dairy manufactural" base is considered, with

butter, condensed and evaporated milk, powdered milk, and other manufactured products taken into account the production of northwestern Illinois is a part of the great manufactural portion of the American Dairy Belt west of Lake Michigan, including all of Wisconsin except the southeastern portion of the state, northeastern Iowa, and eastern Minnesota. In other words, it is part of the manufactural western portion of the Dairy Belt rather than the fluid milk-producing eastern portion.

LOCATION AND SURFACE OF THE DAIRY REGION OF NORTHWESTERN ILLINOIS

The dairy region of northwestern Illinois is a long, rather narrow area along the Wisconsin state line (Figure 3). It lies in the very southern portion of the Driftless Area (Jo Daviess County, the northwestern corner county of the state), or in a maturely dissected region thinly mantled with old, Illinoian glacial drift, whose present land forms are due primarily to stream erosion rather than to glaciation (Stephenson County). Over large areas the drift cover has been entirely removed. The area is more like the Driftless Area of extreme southwestern Wisconsin than it is like the regions of new glacial drift (Wisconsin age), or the till plain of most of Illinois. Long low slopes between broad, undulating ridge tops and flat-floored and alluvial filled valleys characterize the area (Figure 4). Practically every acre of land possesses some degree of slope. All the land except the alluvial valleys is well drained. The countryside expectably becomes rougher toward the Mississippi River, with its lower base level, than it is on its eastern side, drained by the Pecatonica, a tributary of the Rock, in turn a tributary of the Mississippi. The entire area is a rolling plain with relative relief of 150 to 300 feet, or locally a rough plain, with relative relief of 300 to 500 feet, especially toward the Mississippi. The land surface of the region is tilted southward. Both ridge tops, many of which were original prairies, and valley bottoms decline in actual elevation southward. The highest elevations on the ridges are at the Wisconsin state line, generally from 1000 to 1100 feet above sea level. Charles Mound, 1241 feet, the highest elevation in the region as well as the highest point in the state of Illinois, is within a quarter of a mile of Wisconsin.

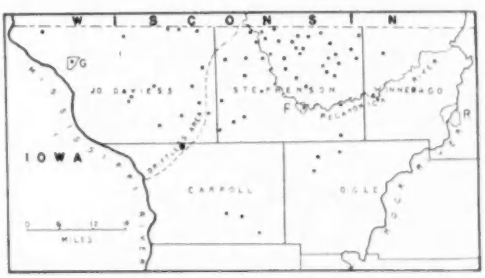

FIGURE 3.—The dairy region of northwestern Illinois. Each dot represents a cheese factory or creamery. The cheese factories are most concentrated in northern Stephenson County and in eastern Jo Daviess, and are most numerous toward the Wisconsin state line. The G indicates Galena, the F Freeport, and the R Rockford.

The lowest elevations are 750 feet above sea level along the Pecatonica bottoms and just under 600 feet along the Mississippi. The region is in fact the southernmost back slope portion of the great Galena–Black River cuesta, whose escarpment face is at Military Ridge to the north in Wisconsin. Cuestaform features are locally significant in the region, and many of the higher mounds, rising above the undulating ridge tops, are outliers of the nearby Niagara Cuesta, while other ridges toward the Mississippi are the escarpment faces of the Niagara itself. No matter, however, what the specific physiographic feature, slope is the characteristic geographical factor of the landforms, slopes not too

steep to be cultivated, but slopes better devoted to pasture than to crops, slopes that rise and fall in gentle undulations, slopes that hide the nearby landscape without affecting the distant view, and slopes that definitely set the region apart from the glacial valley train of the Rock River Valley to the east and the Illinois till plain some distance to the south.

BOUNDARIES OF THE REGION

The actual boundaries of the Dairy Region of northwestern Illinois are zonal and transitional rather than sharp, and are cultural and economic rather than natural. While geographers dislike to think of counties as geographic regions, this region is in large part made up of two counties, Stephenson and Jo Daviess. All of Stephenson County and eastern Jo Daviess are in fact the intensive dairying heart of the region, though dairying continues westward to the Mississippi. However, it is diluted in that direction by many corn-beef cattle farms, and by the lead and zinc mining of the Galena-Vinegar Hill district. On the north the state line serves to divide the region from Wisconsin, with which, however, all of the Swiss cheese factories are closely integrated, since all warehousing and marketing of Swiss cheese takes place through Wisconsin centers. On the east, extreme western Winnebago County lies in the area, and Durand (no relation) and Pecatonica are cheese manufacturing centers. On the south the border is even more transitional than it is to the east. Beef cattle and dual-purpose cattle, however, begin to increase in numbers, and livestock farms exceed dairy farms in importance. Thus in Carroll and Ogle counties to the south the dairy enterprise fades, cheese factories become fewer (Carroll County has but three cheese factories, Ogle three) until, through a twilight zone the beef cattle-corn-hog farms of the Illinois Corn Belt have almost completely replaced the dairy farms in the regional economy. The specific dairy region is thus small in area, and is tucked into a rough quadrangle between Wisconsin and the Mississippi River along the northwestern border of Illinois (Figure 3). Yet, even with the ease of overlooking this segment of the American Dairy Belt it must be remembered that the region is significant enough to boost Illinois into second position in manufacture of Swiss, Brick, and American cheese nationally.

FIGURE 4.—The undulating to rolling plain of northwestern Stephenson County, Illinois, near the border of former prairie and woodland country. The wooded and pasture land in the foreground is what remains of a woodland enclave known originally as Waddams Grove. The relief, from the site of the camera to the wooded valley in the middle distance, is just under 300 feet.

DAIRY LANDSCAPE OF THE REGION

An undulating to rolling checkerboard of cropped fields, pastures and woodlands dominates the general scene in northwestern Illinois; the rectangular mosaic is modified locally by irregular fields, pastures, and woodlands where slopes too steep for most efficient cultivation, or valley bottoms of dendritic design, thread in and out to interrupt the major, more orderly, pattern. The rectangular pattern is dominant in the eastern two-thirds of the region, especially so on the broad, undulating upland between the drainage of the Pecatonica and the tributaries of the Mississippi, and in the rolling hills of the Pecatonica drainage basin itself. The western one-third of the region, the direct drainage basin of the Mississippi via the Apple and Galena rivers is much more cut-up, dissected, and irregular. Numerous serpentine ridges, outliers of the Niagara Cuesta, complicate the land surface. The result is that practically no roads are on section lines, field boundaries are commonly irregular, and the region has but little trace of the implied rectangularity imparted to it by the original United States land survey. This rougher, less regular area, entirely in western Jo Daviess County, is the portion of the region in the Driftless Area, although the present degree of dissection of the surface is largely related to adjacency to the Mississippi. (Figures 5a and 5b).

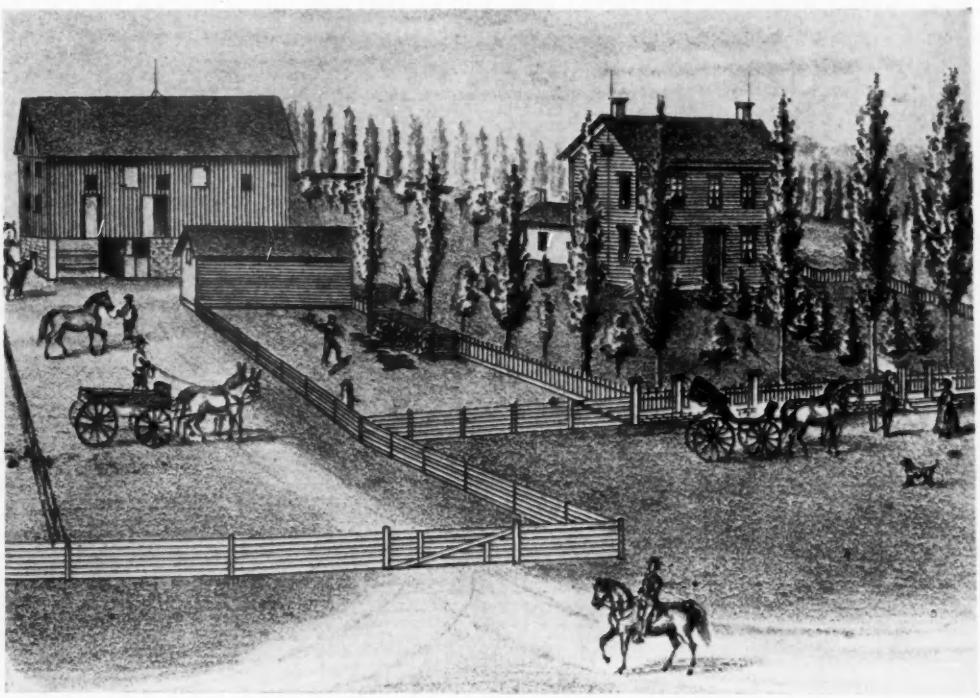

FIGURE 5A.—A Stephen County dairy farm near Orangeville, Illinois, in 1871. Photographed from "Atlas of Stephenson County, Illinois, 1871," published by Thompson and Everts, Geneva, Illinois. Compare with Figure 5b.

Dairy, general, and beef cattle-corn-hog farms occupy the terrain of the area (Figures 6a and 6b). Dairy farms, averaging 130 acres in size are most usual in the eastern two-thirds of the

region, centering in Stephenson County and eastern Jo Daviess County. The 120 to 130 acre size landholding is the common one. From the regional core of these farms throughout the heart of the region, the size of farm increases outward toward the regional borders—increasing to average farm sizes of 170 to 200 acres in the rougher lands toward the Mississippi and to 160 acres averages southward into the Corn Belt. The typical and representative dairy farm, however, in the region is the 120 acre landholding. Tenancy is high, 40 per cent, but less than on the margins of the Corn Belt to the south, where it rises to more than 50 per cent. In Stephenson County 57 per cent of the land area is crop land, 32 per cert is pasture, plowable or woodland and lowland pasture, and a little over three per cent present woodland. In Jo Daviess the equivalent figures are 36 per cent, 42 per cent, and eight per cent, figures which in themselves, even though on a county basis, depict the roughening of the surface westwards, with less crop land and more pasture and woodland the result. In addition mining land, unused bottomland of the Mississippi, and rough non-farm land constitute an appreciable amount in total. The lead and zinc mines of the Galena area likewise characterize the landscape of the western portion of the region, the mine buildings rising among some fields, and mine dumps covering others, while small mining communities are interspersed with the more usual agricultural service villages, the village type common throughout the majority of the area.

Within Stephenson and Jo Daviess, 38 per cent and 18 per cent respectively of all farms were classified as strictly dairy farms by the 1940 census, on the basis of income from dairy products. The remaining farms of Stephenson

FIGURE 5B.—The same farm depicted in Figure 5a in July 1945, seventy-four years later. While the farmhouse has been completely remodelled, the original barn has undergone but little change. The chief change has been the construction of windows to admit more light into the basement of the barn.

County, and a large remaining percentage of Jo Daviess fall into a dairy combination or a livestock classification, a factor evident in the region, both toward its southern transitional border and toward the Mississippi, both being sections wherein the dairy enterprise is diluted in intensity by livestock and Corn Belt farming, and where, in the western part, considerable numbers of sheep are maintained.

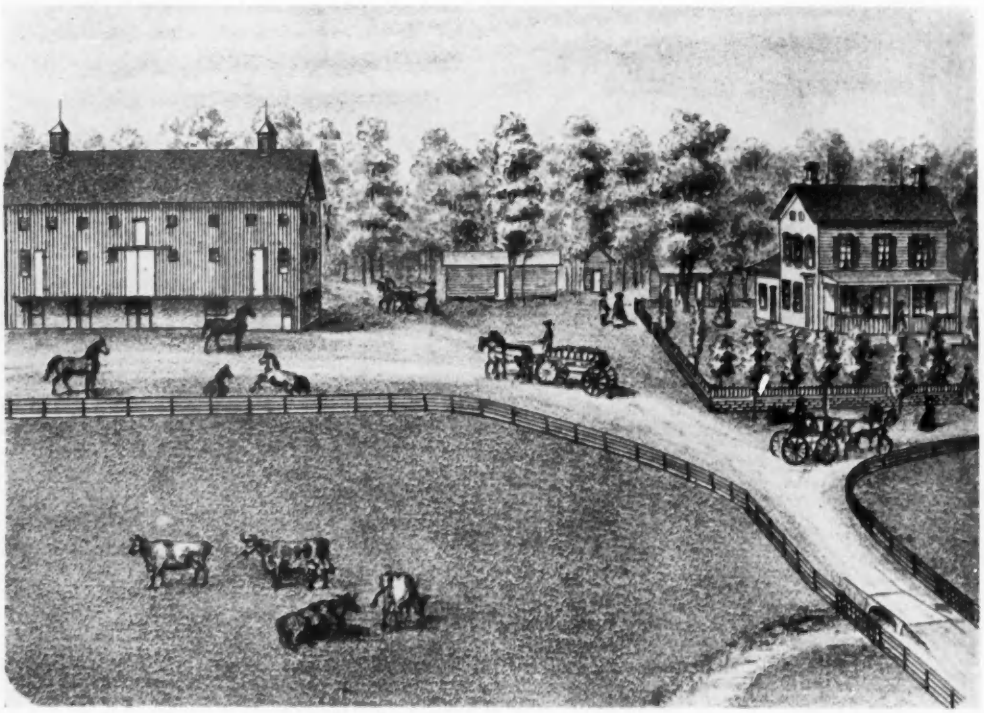

FIGURE 6A.—After a short frontier period of wheat production the farmers of northwestern Illinois turned to the dairy industry as a source of income, as in adjacent Wisconsin. Some dairying was introduced directly by settlers from New York and Pennsylvania, familiar with the industry in their original homes. German and Swiss immigrants also engaged in dairying from early settlement days. The presence of large dairy barns in the 1860's and 1870's is conclusive evidence of the early establishment of the industry. The barn here pictured was sketched in 1871 for the Stephenson County Atlas. Compare with Figure 6b. (Photographed from Stephenson County Atlas, 1871.)

The farms of northwestern Illinois devote their crop land almost entirely to hay, corn, pasture grasses, and oats. Corn is raised both for grain and silage; oats are used primarily on the farms themselves for feed; and the hay is stored in the lofts of the barns for winter feeding. Concentrated dairy feeds may be purchased from the dealers in the villages, or ground in part from products grown on the farms. On the typical dairy farm the crops observed in the fields in summer are used, however, on the farm itself. It is the milk sold from the farm, plus associated livestock and poultry products, that represents the output of the farmer, and provides him with his income. Daily circulation on the highways is in large part a circulation induced by the daily delivery of milk to cheese factory or creamery, and far exceeds in importance any seasonal circulation involving shipments of grain or other seasonal products.

Large and substantial basement barns, usually of the bank type, are outstanding in the cultural scene. Silos, milk

houses, machine sheds, and poultry houses complete the working buildings of the farmsteads, while modest, though substantial frame farmhouses shelter the family operators. All buildings are well painted and kept in repair, the farmstead scene being one of relative prosperity of the American Dairy Belt. The value of the farm buildings constitutes nearly half of the value of the farms, the high percentage of total valuation in buildings being a usual feature of American dairy regions.

Holstein, Guernsey, and Brown Swiss cattle, chiefly the former, dot the spring, summer, and autumn landscape—grazing in the bottomland or sidehill pastures, in woodland pastures, or in the fields seeded in a particular year to pasture grasses, and otherwise used as part of the crop rotation system. In winter, the cattle are housed in the large and substantial dairy barns of the region, but nevertheless may become a visible element of the landscape on certain days, or at certain times of the day, when in the snow-covered barnyards burrowing into the strawstacks, transforming the latter to a mushroom shape. Over 90 per cent of the farms of the entire region possess dairy cattle (cattle kept for commercial sale of milk), the actual number of such farms being in excess of 4000. Only 400 farms in the entire region report cattle as kept primarily for beef, and of those but 110 are in Stephenson County, the heart of the dairy area. Further statistical evidence correlating with the visible features of the landscape is the high production of milk per year per acre of crop land—90 gallons for Stephenson County and 74 for Jo Daviess, the former figure indicates intensive dairying, the latter indicates important dairying, and is high enough to be included in the dairy zone of the United States. The two counties immediately south of this region have milk productions per year per acre of crop land of 45 gallons—Carroll County—and 34 gallons—Ogle County. The counties to the north in Wisconsin reach higher figures, Green 197, and Lafayette 119. Regionally the figures reflect the "overflow" nature of the region from the

FIGURE 6B.—The same barn shown in Figure 6a in July 1945. A silo has been added, and a "driveway" (see Figure 7) has been built along the front of the barn, eliminating the "overhang" so common in barns of the Pennsylvania Dutch and in parts of Wisconsin. Note that the windows and the cupolas are the same as in Figure 6a.

Wisconsin dairy area to the north, and its juxtaposition to the Corn Belt immediately to its south, a position evident in the field from many visible elements of the landscape.

Herds are "average" in size for much of the American Dairy Region, but not so large as in the very intensive dairy districts of southeastern Wisconsin-northeastern Illinois, and the region of central New York state. More than 85 per cent of the farmers milk in excess of five cows, 60 per cent milk ten or more, and 40 per cent milk 15 or more. The modal group is the ten to 14 group, and no farmer within the region milks as many as 50 cows (Figure 7). The region is a typical "dirt farming" area, and does not contain the "super-dairies" of the country estate, or "factory" type found near many large cities, financed and operated by companies or by wealthy individuals. The greatest number of cattle, classified within the size group milked, is represented by the ten to 14 cow herd. Northward in Green County, Wisconsin, the modal group is the herd of 20 to 29 cows; southward in the Corn Belt it is the five to nine cow herd. The herds of the region average larger toward the Wisconsin line, particularly in the northern part of Stephenson County, and smaller toward the transitional boundary to the Corn Belt.

FIGURE 7.—A Stephenson County farm with a "driveway" built in front of it. (This is not the same barn pictured in Figures 6a and 6b.) One former cupola remains, while modernization has included the addition of ventilators. Such a structure was used for intensive dairying from the start. The barn was built by an eastern settler named Pollock, and at present is on the farm of the grandson of a Swiss settler who purchased the farm in 1875, the farm having been operated by the latter family (Babler) for seventy years.

DAIRY PRODUCTS OF THE DAIRY REGION OF NORTHWESTERN ILLINOIS

Cheese is the outstanding dairy product of the dairy region of northwestern Illinois, and cheese factories, located at or near rural crossroads, are the dominant cultural factor in the landscape so far as dairy manufacturing establishments are concerned (Figure 8). Cheese factories outnumber creameries of the area by more than five to one, though the average factory is smaller than the average creamery. More than half of the cheese factories of the state are located within the region, a manufacturing area for dairy products since its early intensification in dairying during the decade 1880 to 1890. The other cheese factories of Illinois are not concentrated regionally, as are those of the northwest, but are widely scattered throughout the state, and, for the most part, are of recent founding (Figure 10).

The cheese factory of the region is similar in construction and location to the cheese factories of southern Wisconsin (See Loyal Durand, Jr., *The Cheese Region of Southeastern Wisconsin*, Eco-

NOMIC GEOGRAPHY, Vol. 15, 1939, pages 283–292). Those engaged in the manufacture of Swiss cheese, in addition to containing different kinds and shapes of cheese vats from those manufacturing American cheese, usually have somewhat larger storage cellars, since Swiss cheese is kept at the factory for a month or more for preliminary curing, whereas American cheese is moved to central warehouses within a week of its manufacture (Figures 9a and 9b).

The great majority of the dairy farmers patronize the nearby cheese factory, spaced at three to four mile intervals through large parts of the region, particularly northern Stephenson County. Whole milk is delivered each morning to the factory. Whey from the previous day's manufacture is returned to the farm to be fed to swine, the cheesemaker in the meantime having run the whey through a separator in order to extract the whey cream for sale to a creamery. The farmers patronizing creameries sell only the butter fat, the skim milk being retained on the farm for feed.

Freeport, the master city of the region with a population of 22,000, is not only a center of manufacturing of the urban type, but is also the site of cheese warehouses for American cheese, and of a cheese processing plant for the manufacture of process cheese, the raw material for which is already manufactured natural cheese. The warehouses of Freeport have at times stored nearly 80 per cent of all American cheese made in Illinois. No warehouse centers for foreign-type cheese (Swiss and brick) exist within the Illinois segment of the entire region, the Swiss and brick cheese moving across the state line to Monroe, Wisconsin, and Brodhead, Wisconsin.

Creameries, in contrast to cheese factories, are located in the villages. Their raw material need only be collected two to three times a week, and is usually drawn from a wider area than is the raw material for the cheese factories. Creameries are more numerous toward the western, or Mississippi River side of the region.

MANUFACTURE OF SWISS AND BRICK CHEESE

The manufacture of Swiss cheese in northwestern Illinois is highly concentrated within the region. The majority of cheese factories manufacturing this product are located in the very intensive dairy districts of northern Stephenson County, in juxtaposition to the

FIGURE 8.—The El Dorado cheese factory, located at a rural crossroads one mile south of the Wisconsin state line. The receiving platform for milk delivered by farmer patrons is in the center, the whey tank is at the right.

Wisconsin manufacturing area, and adjacent to the state line. The great majority of the factories are at rural crossroads within ten miles of Wisconsin. Nearly all lie between the latitude of Freeport (15 miles south of the state line) and Wisconsin (Figure 3). The industry is truly an "overflow" gional product. Milk from the herds is delivered daily to the crossroads factories. In the past, Swiss cheese manufacture was a twice-a-day enterprise, milk being delivered in the early morning and early evening; manufacture of the wheels of Swiss cheese was carried on from about seven in the morning

FIGURE 9A.—A cheese factory in Illinois, photographed from Wisconsin. The edge of the barn to the right, and the man, is in Wisconsin, while the state line is parallel to the building, and just on the near side of it. Most of the milk for this Swiss cheese factory originates in Wisconsin, the cheese is marketed through Monroe, yet the cheese can not be marked with the Wisconsin state brand. The fields in the distance are in Illinois. There is no state line road at this point, the factory not being at a crossroads.

from the major Swiss cheese district of the United States, the intensive producing area centering upon Green County, Wisconsin, and founded originally by the Swiss colonists of the New Glarus region. Ever since its founding the region of manufacture has spread from its original center, into areas settled by other nationalities as well as by Swiss, and has spread southward to and beyond the state line. The district is merely segmented by the political border into a larger northern producing section in Wisconsin and a smaller one in the dairy region of northwestern Illinois.

The ebb and flow of daily traffic on the highways revolves around the re- until noon, and from seven in the evening until midnight. Modern farm refrigeration plants have done away with twice-a-day manufacture; a few factories revive it periodically during periods of excessive heat in summer. Factory operators of Swiss birth or descent operate many of the factories, and it is not uncommon for the operators to have learned the industry in Switzerland.

Brick cheese is made in a few factories as a major product. More commonly it is a product of the Swiss cheese factories in the winter season, when the flow of milk is less and not enough raw material may be received for a 200 to 230 pound wheel of Swiss cheese. Con-

sequently the diminished supply of milk is made into brick cheese, each of about a five to ten pound size.

ELEMENTS OF INTERSTATE UNITY IN SWISS CHEESE MANUFACTURE

The product of the Swiss and brick cheese industry of Illinois, tied as it is to Wisconsin, moves freely across the state line. Factories located on the state line road, or near it, receive part of their raw material from Wisconsin farms. Illinois farmers elsewhere deliver milk to factories on the Wisconsin side of the border. Trucks from both states collect the wheels of cheese for transportation to warehouses at Monroe and Brodhead. Illinois cheesemakers look to Monroe as the capital of their industry, the source of their cheese factory supplies, the location of their price quotations, the center of their regional and trade gossip, and the headquarters of their industry in the United States. Days and evenings away from the factories are commonly spent in Monroe, a center for various social organizations whose memberships, official or otherwise, are recruited from the ranks of the cheesemakers and their apprentices. In short, nearly all the elements of the ebb and flow of commerce and social intercourse connected with the industry was back and forth over the line as if it were nonexistent (Figure 8).

ELEMENTS OF REGIONAL SEGMENTATION INDUCED BY THE EXISTENCE OF THE STATE LINE

The existence of the state line has an appreciable effect on certain phases of the regional whole, aside from such usual effects as taxation, differing state laws affecting everyone, and other common boundary functions. Wisconsin, as a state, is "dairy conscious." The legislature appropriates money to advertise Wisconsin dairy products. Stringent state laws have been enacted defining the moisture content of all varieties of cheese, the grading of cheese, and other safeguards to protect a state industry. Illinois as a state is much less dairy conscious. The Illinois Swiss cheese industry, integrated to Wisconsin conditions and marketing arrangements, hugs the state border, yet is unable to obtain preferential treatment in some of the tangible results of the Wisconsin attitude. Wisconsin state cheese graders do not inspect and grade the cheese manufactured in Illinois, even though it reposes in the same warehouses with

FIGURE 9B.—The "factory" end of the cheese factory shown in Figure 9a, also photographed from Wisconsin, though everything in the picture is in Illinois. The receiving door and windlass for lifting milk cans are in the center, the entrance to the factory room and boiler room is at the right. Several of the wooden frames for pressing the wheels of Swiss cheese are stacked in front. Each of the wheels of cheese is of this size, and weighs about 235 pounds when ready for market. An old, and overturned, kettle, in which the milk is placed and the cheese is manufactured is on the platform at the left. The cheesemaker served his apprenticeship in Switzerland.

Wisconsin Swiss. It is graded separately by the warehouses, and stamped with the name "Illinois." Cheese made in Illinois, even on the state line road, cannot be stamped with the "Wisconsin State Brand" mark, advertised nationally through the system of state aids. While Illinois cheese benefits no doubt from the advertising, is manufactured in the same region and shipped eastward through the same warehouses, it is within Wisconsin a misdemeanor to mark it "Wisconsin cheese." Individuals and companies have been hailed into Wisconsin courts, and fined for so labelling it at times in the past.

MANUFACTURE OF AMERICAN CHEESE

The Swiss cheese area on either side of the Wisconsin-Illinois line grades westward, into a region manufacturing American cheese, likewise straddling the border. The crossroads factories of central and western Jo Daviess County are south of the American cheese districts of southwestern Wisconsin, in western Lafayette and Grant counties. These factories in the dairy region of northwestern Illinois are neither so numerous nor so concentrated areally as the factories manufacturing Swiss cheese. They compete for raw materials with village and small town creameries in the area. The whims and farm practices of the individual farmer play a part in the competition. Those farmers desiring skim milk for use on the farm prefer to patronize creameries, selling only their separated cream. The creamery area of northwestern Illinois, and the mixed creamery and American cheese factory area, is less intensively engaged in dairying than the Swiss cheese region. Dairy farms are fewer in number and fewer in percentage of all farms. The farms are larger, and

FIGURE 10.—The farmyard cheese factory of Thomas P. Steere of northern Stephenson County, 1871. Existence of these local factories in areas settled by New Yorkers, Pennsylvanians, and Swiss is conclusive evidence of the early start of the cheese industry in Stephenson County, as in adjacent Wisconsin. This factory was located less than two miles from the Wisconsin state line. The building still stands, and is used for storage of hay and grain. McConnell, Illinois, six miles away, was originally known as New Pennsylvania. (Photographed from Stephenson County Atlas, 1871.)

contain more rough land, partly because of the rougher topography. Fewer cattle per farm are milked. There is less milk production per unit of cropped land, as shown by the county figures for Jo Daviess and Stephenson.

Marketing and warehousing arrangements for American cheese are separate from those for Swiss. Freeport receives the product of the factories of northwestern Illinois, as well as cheese from some Wisconsin factories, and cheese from scattered factories elsewhere in northern Illinois. Its warehouses store extra-regional as well as regional cheese. Some of the cheese may be processed in Freeport, while the rest is shipped to Chicago or eastward for sale as natural cheese.

TRENDS AND CONCLUSIONS

The dairy region of northwestern Illinois is adjusted to its environment. Lying on the border of the Dfa-Dfb climates with a growing season of 140 to 155 days, shortest in Illinois, at the northern border of the American Corn Belt, and in the southern portions of the Driftless Area and dissected old Drift region, it is a region better used for feed crops, hay, and pasture than for intensive corn production. The regional erosional problem is under better control in the type of farming system followed than it would be in many other types. The farm population is conditioned to the dairy industry, an enterprise involving strict daily attention to the affairs of the farm and placing limitations upon the degree of independence; the farmer is tied to his herd 365 days a year. Fifty to 60 years of intensive dairying have set a pattern followed by succeeding generations.

Markets are provided for the product of the farm. Cheese factories persist in the area in part due to its location with respect to present demands for urban milk. Regions closer to market furnish the fluid milk. Large dairy concerns have built warehouses and processing plants in the region, a guarantee of future faith in its continued production of cheese.

Cheese production has increased throughout past decades, in part as a spread from the successful Swiss area of Wisconsin, which has acted as a stimulus. Illinois Swiss cheese production has surpassed that of Ohio, formerly the second state to Wisconsin in production. The industry is apparently intensifying, in part, no doubt, because of exigencies of the present war, provision of a large market, not to mention government exhortations to the farmer and cheesemaker. This increase has taken place despite the diminution of total number of factories within the heart of the region. New factories have however, been built west of the heart, and the region of cheese production seems to be expanding westward to the Mississippi (as in extreme southwestern Wisconsin to the north).

Tradition and pride in a regional product will probably hold the cheese industry in northwestern Illinois for some time to come, perhaps indefinitely. The chief chance for decline or extinction of the industry is the possibility of expansion areally of the Chicago fluid milk market, a possibility that would engulf the industry as in the past in portions of New York state. However, the major pattern of the Chicago milkshed is not one spreading toward northwestern Illinois. Illinois today holds second position among the states in cheese production. The dairy region of northwestern Illinois contributes nearly all of the Swiss and brick cheese to this total, as well as an appreciable amount of the American cheese, and thus takes its place of significance among the various regions of the American Dairy Belt.

AGGLOMERATED SETTLEMENTS IN THE NEW BRIGHT TOBACCO BELT

Parnell W. Picklesimer

IN the New Bright Tobacco Belt of North Carolina—an area of approximately 5,000 square miles—there are many agglomerated settlements, where life revolves principally around the production and marketing of one commodity—tobacco (Figures 1 and 2). Altogether, these settlements harbor nearly 32 per cent of the total population. Failure to consider their place and function in the area would be to neglect a major geographic fact, since in many respects these communities are as important as the rural portions in which they have their setting. The development has been slow and varied, but apparently very representative of many less highly urbanized farming areas of the nation.

Historical Development

During colonial times, town life did not appeal to the inhabitants of the region, despite the fact that the proprietors and the English King desired the planters to organize themselves into such communities. It was difficult to convert planters to urban ways of living. Along the larger watercourses there were a few hamlets, where a few settlers and perhaps a merchant or two lived. From the standpoint of commerce, they were of little significance. At times, they became centers of religious devotion and occasional political conflicts. Some of these hamlets became boroughs, and functioned largely as seats of government. Some efforts were made to locate towns with regard to the natural transportation facilities, but by 1800 most of these communities were small and significant only as seats of justice.

There were, in fact, no towns in the region prior to the nineteenth century. They made their appearance first in the period between 1815 and 1825, during the fervor for internal improvements. In 1815 there were only a half-dozen small towns in the entire area: Smithfield, Greenville, Kinston, Waynesboro (Goldsboro), Tarboro, and Snow Hill. Duplin, Nash, and Wilson counties had no towns at this time. A further stimulus toward urbanization came with the advent of the railroads just prior to 1850. But even as late as the Civil War the only towns having a population of more than a thousand were Kinston and Tarboro.

At present the New Bright Tobacco Belt is interspersed with many country stores, villages, towns, and small cities. These settlements have not developed of themselves, but are grown-up crossroads. They exist to facilitate exchange and are largely focal points where the surpluses of producers and the demands of consumers are brought together. Generally speaking, these agglomerated communities are rather uniformly spaced throughout the area and their service zones reach most of the inhabitants at distances not to exceed five miles.

The Country Stores

Although not classed as agglomerations, country stores are service centers filling an important need in rural economy, and their functions cannot be overlooked. These stores are more often located at the intersections of the more frequented roads, and are, for the most

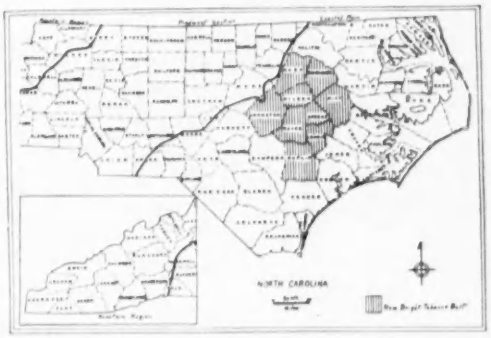

FIGURE 1.—Map of North Carolina, showing location of New Bright Tobacco Belt.

part, general stores, selling many kinds of goods and serving somewhat as entrepôts for a limited variety of farm products. Where the roads are poor, the stores are at shorter intervals because the inhabitants cannot readily travel far to reach them. The construction of improved roads in some localities has recently enabled the rural people to shop at greater distances from home and larger stores in villages and towns, offering a greater variety of merchandise, have thus secured increased patronage. The change has resulted in the abandonment of many small stores. Such stores as do continue in business usually have a gasoline station for motorists in addition to their general stock of merchandise.

THE VILLAGES

There are 32 incorporated villages in the Belt, agglomerations with a population of less than 500 (Figure 2). These villages, as in the case of the country stores and many other small unincorporated centers, are situated at the intersections of highways and along railways and enjoy central locations in relatively small areas, the size of which is largely dependent upon the condition of the roads. They were established primarily as service centers for the surrounding trade territory. Most of them are without banks or industry. Many things have happened in recent years, however, somewhat to defeat the purpose for which these villages were established. Improved highways make it easier for farmers to go to the larger trade centers where the stores are better and where merchants handle specialty lines or do volume business. Mail order houses and parcel post facilities are also responsible for cutting down sales of local merchants. In some instances natural resources that gave birth to villages, such as forests, have been consumed. These and many other factors have had their effect. It is doubtful, therefore, whether most of the villages that attempt to exist purely as trade centers can hold their own. It is apparent that the most thriving villages of the area are those that are attempting to become something more than trade centers. Some of them are establishing small industries, such as cotton gins, saw mills, garages, and shops for the repair of farm implements and machinery; others are being made

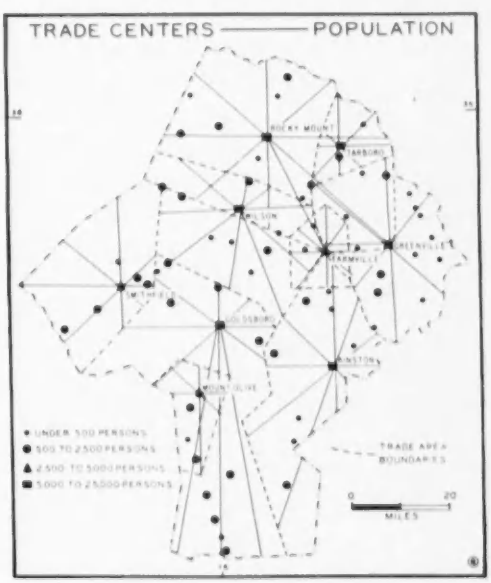

FIGURE 2.—Map showing location of trade centers and the areas they serve.

into attractive residence centers. Those failing to make such adjustments are more often declining in population or increasing at a snail's pace. In general, the larger the village the greater the percentage increase in population and the brighter the future outlook.

TOWNS AND CITIES

In addition to the villages, there are 39 agglomerations in the region which range in population from 500 to about 25,000 (Figure 2). Only five have populations ranging between 10,000 and 25,000. Although all are primarily trade centers for their particular localities, many differ in one or more specialized trade functions, so that they may be grouped as tobacco marketing towns, truck marketing centers, and county seat towns. There is, however, considerable overlapping, since a town may serve as a county seat and a market for both tobacco and truck crops.

TOBACCO MARKETING TOWNS

There are nine tobacco marketing towns in the area, as follows: Wilson, Rocky Mount, Greenville, Kinston, Smithfield, Farmville, Goldsboro, Wallace, and Tarboro (Figure 2). From the standpoint of total tobacco sales in 1944, these towns ranked in the order named. Although Wallace is a small tobacco marketing center, it is more important as a vegetable market, and therefore belongs to both groups. The larger tobacco markets are located in the principal trading centers and in the heart of the area of the most intensive tobacco production. Smaller markets, while they may be located in areas of heavy production, have marginal trade locations. Wilson and Farmville are quite representative of the two types; each is treated here in some detail.

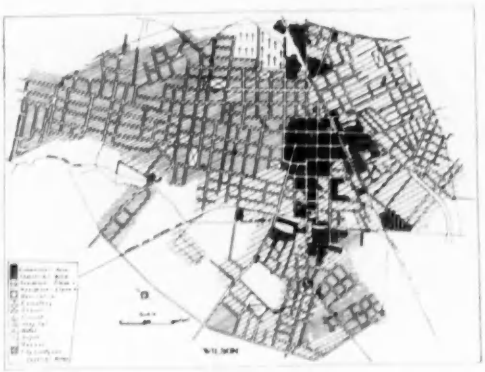

FIGURE 3.—Wilson, a city of nearly 20,000 and the largest tobacco market in the Belt.

Wilson

Wilson has a population of nearly 20,000 and, although smaller than Rocky Mount by about 5,000, is the leading tobacco market in the Belt. Prior to 1890 the town's progress was slow, but during the decade 1890–1900, several important developments took place. In 1890 the first tobacco warehouse was built here, which proved to be a great convenience to farmers, who had previously been compelled to market their product at greater distances from home. (A tobacco warehouse is not a storage warehouse, as the name might seem to indicate, but is a place where tobacco is brought for immediate sale. Wherever tobacco is stored for aging purposes the structure is referred to as an aging warehouse.) In fact the growth of the town may be dated from this first tobacco sale. Manufacturing was also introduced by the Hackneys, who began building wagons for a wide trade area. In 1892 and 1893 the town built and began the operation of its own electric power and water plants, a project which later proved effective in lowering the municipal tax rate. But the most important factor in the town's growth was the building of the Norfolk-Southern railway, giving modern connection and transportation east

and west. The Atlantic Coast Line had long given service north and south. These rail contacts, together with a splendid system of highways radiating outward, has placed Wilson in an enviable position commercially among the other agglomerated settlements of the region.

Wilson, like other towns of the region, is divided largely into an area of work and an area of residence, yet there is no distinct line of demarcation between the two (Figure 3). The retail district, for example, is centrally located, with the exception of many small establishments that are scattered throughout the residential and industrial areas for the greater convenience of adjacent peoples in securing a portion of their wants. In 1944, this retail business amounted to a little more than $15,000,000. The wholesale business is not large, being confined chiefly to groceries and fertilizers, and is located on the outer margins of the retail district and in the vicinity of the railroads, as would naturally be expected. In addition, there are a few industries that provide a limited number of people with rather steady incomes. Among these are plants for the manufacture of bus and truck bodies, fertilizers, cotton oil, cotton yarns, candy, soft drinks, lumber, and seven tobacco processing plants that are in operation for only a few months during the year.

The residential properties of Wilson encircle the trading areas, and there is little intermingling between first and second class residences. The first class residences are largely concentrated in the western part of the town and are, on the whole, among the most beautiful and palatial to be found anywhere in the Belt. This is particularly true of West Nash Street, where many of the executives of the local tobacco industry reside (Figure 4). In close proximity

FIGURE 4.—West Nash Street, Wilson's best residential section.

to the commercial section are a few first class residences which are generally occupied by people of wealth and long-standing in the community. The second class residences, occupied by white people in the lower income brackets and by Negroes, are situated largely in the southern and eastern parts of town. Nearly everywhere the town blocks are rectangular in shape, the streets are wide and well paved, and provide a maximum of ease in movement.

Wilson is best known for its tobacco market. Ten large and well-constructed tobacco warehouses, with a floor space of more than 700,000 square feet, are conveniently located to receive tobacco from a large farm area (Figure 5). Tobacco is often brought here from Farmville's trade territory, as well as from other smaller markets having marginal locations. During the three months of the 1944 marketing period,

FIGURE 5.—A tobacco warehouse, Wilson. This style of warehouse may be regarded as typical of such structures in the Belt, except that some are constructed of sheet-iron and a few of wood.

67,967,582 pounds of tobacco were sold here, bringing an average cash return of $43.29 per hundred pounds. The emphasis placed upon this product and the brevity of the marketing period, however, brings about an awkward situation in which a short and thriving business period is followed by many lean months.

Farmville

Farmville is a tobacco marketing center, located in the western part of Pitt County, with a population of about 3,000 (Figures 2 and 6). There are two reasons for its location: first, the people in this section needed at the time a market closer than Greenville, Tarboro, or Wilson; second, its specific location was selected by an enterprising settler who built a home and established a store there.

Farmville is a young city, having been incorporated in 1872, when its limits did not exceed those of the average city block. Its population in 1880 was 111. It received no special impetus to expand until 1890, when the East Carolina Railroad from Tarboro was completed. The road was originally constructed to haul lumber, but soon began to handle general freight which marked the beginning of Farmville's rapid growth. Prior to this time wagon teams hauled all the goods over almost impassable roads from Center Bluff, a boat landing on the Tar nine miles away. For several years the tobacco farmers in this section, were forced to market their product in Wilson and Greenville, towns a good two day's journey away. In 1905 interested local business men were able to relieve this situation by establishing an adequate home market, which enabled the merchants of the town to supply the farmers with items they needed to purchase. Further progress followed the building of the Norfolk-Southern Railroad from Washington to Raleigh, providing Farmville with east-west rail connections (Figure 7). The period of greatest growth, however, did not follow the introduction of railroads immediately, but came after the state completed its first major road-building program in 1930, which gave the community direct contact with the people of its trade territory (Figure 8). These factors gave considerable impetus to the tobacco industry. During the 1944 marketing period Farmville sold nearly 25,000,000 pounds of tobacco at an average of $43.72 per hundred pounds, thus making the center one of the best small markets in the Belt.

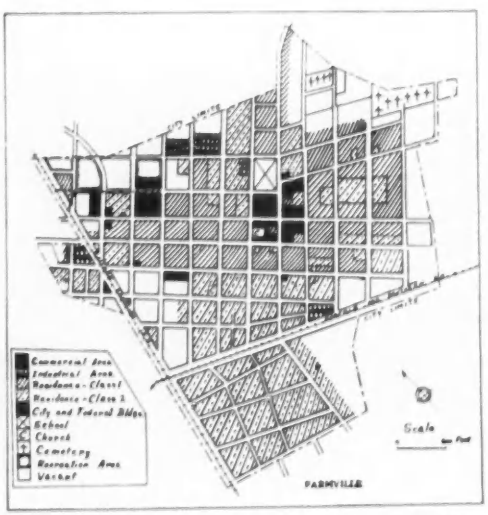

FIGURE 6.—Farmville, a tobacco marketing and trade center of about 3,000 people. The center is typical of the smaller tobacco marketing centers in the belt.

The visitor to Farmville is favorably impressed with the orderliness of the retail district and the slight difference between Class 1 and Class 2 residences. Most homes are well painted and in good repair, a condition indicative of the economic condition of the people. Old established merchants do an extensive time business, the main feature of which is making advancements of supplies and fertilizers to farmers and

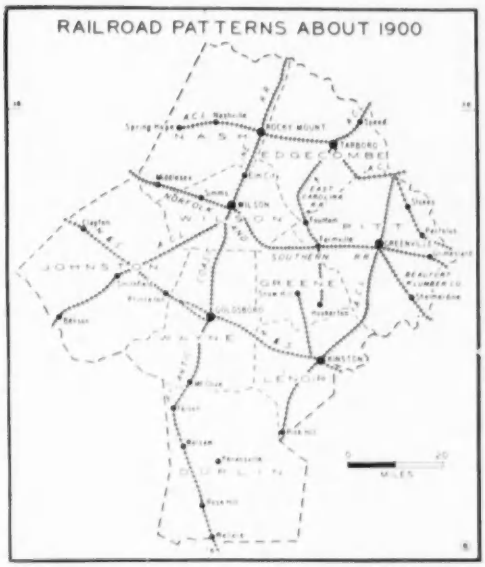

FIGURE 7.—Railway patterns in the region in 1900.

tenants. Industries are few and are dependent upon the products of the farm. They consist of tobacco warehouses and tobacco processing plants, cottonseed oil plants, and a fertilizer factory (Figure 9).

VEGETABLE TRUCK-MARKETING TOWNS

In the southwestern part of the region where the soil is crammed with humus are several small towns that function primarily as markets and collecting points for fruits and vegetables which, in turn, are shipped to larger markets in the North. The chief local marketing centers are Mount Olive, Faison, Rose Hill, Magnolia, and Wallace (Figure 2). All are served by the Atlantic Coast Line railroad and a network of good highways, which have been important factors in their development (Figures 11 and 12).

The town of *Wallace* is especially noted for its strawberry market. In May, farmers bring their berries to the auction sheds in the town, where buyers representing northern firms come to make purchases (Figure 10). About 260,000 crates of 24 quarts each are sold annually. Wallace is also a collecting point for Irish potatoes and a few other vegetables. Shipping is done both by train and motor truck.

In addition to being a fruit and vegetable market, Wallace purchases about 2.9 per cent of the tobacco sold in the Belt. This town, unlike other tobacco marketing centers, may be said to be a two-season town, one for tobacco and the other for vegetables. During the rest of the several months of the year the merchants of the community must be content to sell whatever supplies the people can buy.

Mount Olive is situated in the heart of Wayne County's vegetable producing area. The town is a market and vegetable collecting point, from which hundreds of car loads are shipped annually. Each year some 250,000 baskets of beans and many cars of Irish potatoes are sent to northern consumers.

Faison and *Rose Hill* each has a pickle factory. Faison also ships beans, cantaloupes, eggplant, and peppers. Rose Hill, although just a small village, does

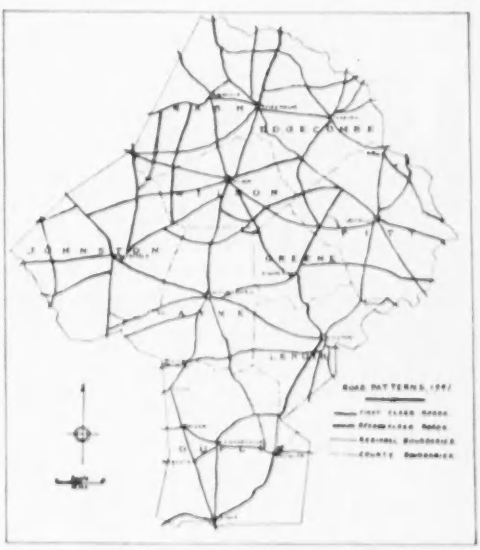

FIGURE 8.—Highway patterns of the Belt.

FIGURE 9.—Tobacco processing plant of the Imperial Tobacco Company, Farmville.

a large berry and vegetable marketing business. In a recent year the village handled 100,000 crates of berries, 95,000 crates of corn, and 3,000,000 flower bulbs. In addition, a local pickle factory offers an outlet for large quantities of cucumbers (Figure 11).

Magnolia is also a large shipper of potatoes, strawberries, beans, and flower bulbs.

Truck marketing centers are small and, like other towns of the region, are to be thought of as centers of supply to the people of the farm communities.

COUNTY SEAT TOWNS

It has been previously shown that yearly all of the tobacco marketing towns are county seats. In addition, there are a few smaller centers that are important only as county seats and small trade centers, such as Snow Hill, Kenansville, and Nashville (Figure 2). They owe their specific locations to some special physical phenomena.

Snow Hill, the county seat of Greene County, is situated on a white sand hill near the center of the county and adjacent to Contentnea Creek, which was once considered navigable for small craft. The town is small, and has had a slow growth since 1900. The main street of the community is wide and well paved, but in the residential sections a large percentage of the streets are without paving. Along the main street are about 15 small variety stores and a few filling stations. With the exception of a bank and a garage, there are no other commercial or industrial enterprises. Tobacco and cotton from the surrounding umland are marketed in Kinston and Wilson. Business generally seems sluggish except when court is in session and on Saturdays, when the rural people come to town to do their shopping and to socialize with their friends.

Kenansville is the county seat of Duplin County, and is located in almost the geographical center of the county. The site was selected primarily because of a good spring, which for many years provided the court and the inhabitants with their only drinking water. The community is largely a one-street town, and has no pavement other than that of the highway which passes through it. There are two garages and a few small stores, but the residents regard the latter as inadequate for meeting their shopping needs. Many people of the community customarily visit the shops in Goldsboro for their more particular needs. Most families living in Kenansville are in some way connected with the business at the courthouse, the practice of law, or the operation of nearby farms. Homes are rather large and have an air of antiquity about them.

Nashville is the seat of government in Nash County and, like Snow Hill and

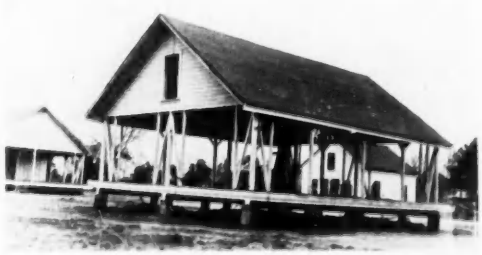

FIGURE 10.—Strawberry auction shed, Wallace.

Kenansville, is located in about the center of the county. The town is spread over a well-drained slope on the fall line between the Piedmont Plateau and the Coastal Plain. The main business street is wide, well-paved, and develops into a beautiful residential boulevard, which is planted with broadleaf Norway maples. Good highways leading to larger and nearby towns provide sufficient trade competition to cause Nashville to remain a small town.

In general, the area is largely rural in character, and the agglomerated centers serve as markets for farm products and places of supply for the people of the surrounding umlands. Economy is based predominantly upon the production and marketing of tobacco,

FIGURE 11.—Rose Hill Packing Company, Rose Hill.

made possible only by stuffing the third-rate soils with commercial fertilizers. There are no mineral resources and only a scrap of manufacturing industry is to be found. Despite the importance of the commercial vegetable industry in the southwestern portion of the Belt, much food is annually imported.

AMERICAN COAL PRODUCTION AND USE

G. E. Harding

IN 1865 W. S. Jerons, speaking on the coal question to a London audience said, "Coal in truth stands not beside but entirely above all other commodities. It is the material energy of the country, the universal aid, the factor in everything we do. With coal almost any feat is possible or easy; without it we are thrown back into the laborious poverty of early times." Since then we have introduced other forms of mechanical energy including petroleum, natural gas, and improved harnessing of falling water, yet all these fall far short of the total energy derived from coal. The great amount of energy stored in coal is not the work of a few years but the product of millions of years of energy stored by the sun. It has been said that one pound of good coal, when burned in an engine, is equivalent to the work one man can do in a day. Granting this to be reasonably true, the amount of energy taken yearly from the mines of the world is incomprehensible to most of us. So vastly important is coal in our modern world that no people or nation can hope to compete with the leading nations of the world unless it has the use of ample stores of good coal.

The Distribution of Coal in the United States

The coal deposits in the United States are Carboniferous to Tertiary in age. Commercial quantities of coal occur in 33 states. Carboniferous coals occur east of the 100th meridian and include the best coal of the country. Cretaceous coals lie between the 100th and 115th meridians; Tertiary coals chiefly between the 120th meridian and the Pacific coast. There are exceptions to this general geographic distribution but, it is a reasonably acceptable regionalization of our coal deposits on the basis of the geological time table. Geological surveys and scientific study have established the realization of the continuity, at earlier geological time, of the now separate coal areas. Erosion and diastrophism have undoubtedly been responsible for the disturbed position of our well known deposits as we know them today. In some regions the deposits seem to have been only slightly disturbed from their original horizontal position, while in other regions the shifting has been considerably marked.

Appalachian Coal Field

The most important coal field in the United States and probably in the whole world is the Appalachian. Closely associated with the Appalachian Mountain uplift, the deposits reflect structurally the influences of the mountain building forces. The field extends nearly 1,000 miles, from Pennsylvania to Alabama, and varies in width from 30 miles to 180 miles. At the northern end in parts of Pennsylvania, the coal measures lie at an altitude of nearly 2,000 feet while at the southern end they pass beneath the deposits of the coastal plain, and probably extend below the Mississippian embayment to connect with the deposits of Arkansas and Oklahoma. All the deposits of the field can be characterized, wholly or in part, by their lenticular forms, their great thickness, the numerous beds, and their many and varied kinds of separation measures. The Appalachian field is divided into two significant

parts: 1) the anthracite deposits of northeastern Pennsylvania; and 2) the bituminous deposits which make up the remaining area.

Production of Bituminous Coal

In 1944, the bituminous coal industry set an all-time production record of 622 million tons of coal, 33 million tons more than was produced in 1943. The 1944 production was also 10 million tons ahead of the amount mined in the record year of 1918 during World War I. These figures are more striking when compared with the 1918 production when there were 615,000 miners while in 1944 there were scarcely more than 400,000 who produced 43 million tons more than in 1918. "This year's (1944) extraordinary production reflects longer working periods, comparatively uninterrupted operations, and a larger increase in strip mining." World War I was a period of very little strip mining. 1943, Pennsylvania alone, produced 25,000,000 tons of strip mined coal. Strip mined coal has been a very decisive factor in maintaining production, because men and equipment used in strip mining are not the same kind as is used in deep mining. During World War I, there was very little mechanization in the coal mines and consequently more men were needed to mine the same amount of coal. In 1918 the amount mined per man per day was 3.5 tons and in 1944, 5.2 tons. For the years 1890–1944, inclusive, the production of soft coal has been steadily increasing while the trend for the production of anthracite coal has, since 1918, been gradually decreasing. In 1890 bituminous mines produced 65 million tons more than anthracite mines but the excess by 1915 had decreased to 344 million tons and to 622 million tons in 1944.

Mechanization and Production

In 1914, anthracite mines employed 180,000 men which was an all time high for the anthracite industry; but the year for maximum employment by the bituminous industry was not reached until 1923 when 705,000 men were employed. Since these dates there has been a steady decline in the number of men employed for several basic reasons. By the end of 1923, the total number of men in all mines was approximately 507,000, yet the production total did not show a decrease. Quite to the contrary, both have increased largely because of the improvements of methods and mechanization of so many mines. In the course of ten years, 1934–1944, the working day was a seven hour day, but after November 3, 1944, because of the pressure of the war, the

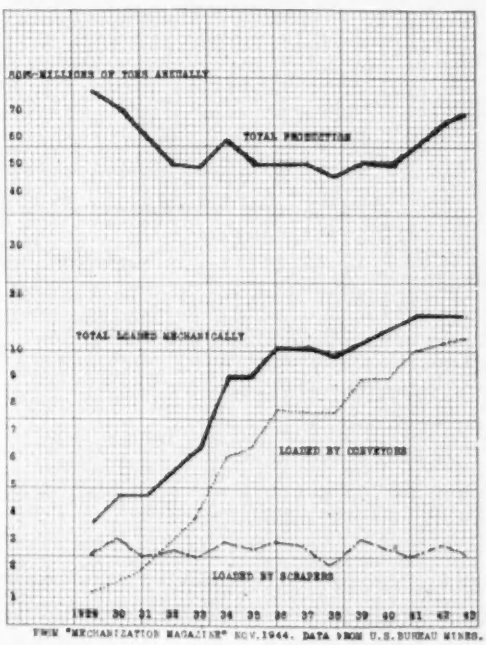

Figure 1.—Relative amount of coal mined mechanically. Two types of loaders were used, 1) conveyor types handling by far the most coal and showing a steady increase, 2) that loaded by scrapers handled much less and shows little change over the same period of time.

FIGURE 2.—Removing the overburden in an Illinois coal field with a 33-cubic yard dipper. The exposed seam of coal can be seen at the bottom. (Courtesy of Bucyrus-Erie Co.)

working day was changed to eight hours. "The year 1942 will be remembered as the first year in which more than half the bituminous production was loaded mechanically. Strip mines produced 11.5 per cent of the total and 40 per cent was loaded mechanically underground. In 1943, these figures had increased to 13.1 and 42.5 per cent, respectively, bringing total mechanized loadings to 55.6 per cent of the nation's bituminous coal." It is logical for us to believe these percentages should increase when the totals for the year 1944 have been compiled. The trends today in the use of mechanical loaders indicate that before long the major portion of all coal will be handled mechanically. With the accepted introduction of mechanical coal cutters and the increasing uses and demands for mechanical loaders, it is quite obvious that the number of men employed under ground is going to continue to decline. Introduction of modern loaders and cutters into many mines may be somewhat retarded because of the wartime restrictions on the production and purchase of necessary equipment to fully mechanize the mines as fast as we would normally expect. It has been predicted that by 1950, 85 per cent of all coal will be mechanically loaded. This conclusion was reached by comparison with the coal cutting machinery whose use struck a level at 85 per cent, and because the trend in the uses of loaders is paralleling the use of cutters. Mechanical conveyors and machines used in mining coal are more advantageously used in the mining of bituminous coal than in mining anthracite. This is because of the irregularity in the anthracite beds caused by folding and faulting. Horizontal position of

FIGURE 3.—Removing the overburden in a Pennsylvania anthracite field using the largest of a dragline excavator manufactured. A 25-yard drag bucket is attached to a 180-foot boom. (Courtesy of Bucyrus-Erie Co.)

the bituminous beds lend themselves quite advantageously to the use of all kinds of mining machinery and it is here that introductions are encouraged. Bituminous coals are conveniently divided into two groups for mechanical application; that loaded by machines and that handled by conveyors. Machine handled coals are those physically suited to handling by mobile loaders, conveyors, and scrapers, while those suited to conveyor handling include coal from pit cars and hand loaded conveyors. In the first case the machines handle nearly 100 per cent of the coal while in the second considerable hand work may be needed, yet it does materially reduce the hand shoveling. Trends in mechanically handled coal seem to

vary considerably with states. It is hard to account for the variation in all instances yet it is logical to conclude that it is for several reasons: 1) old established mines are less inclined to change, 2) new mines opening in new fields tend to modernize, 3) decrease in available labor, 4) increased demands for greater output, and 5) other less obvious but local reasons.

Strip-Mining

In periods of great demand for coal, strip-mining always booms. During World War I thousands of acres of

Figure 4.—A horizontal thrust shovel in a Kansas strip mining field. This type is designed to remove thin seams of coal. (Courtesy of Bucyrus-Erie Co.)

land were made useless and unsightly by overdevelopment in strip-mining. Like all overdeveloped enterprises, it declined during the depression years to such an extent that it was non-existent in most regions. But since the outbreak of World War II, it has been vigorously revived and, in many places, greatly extended. "The tremendous wartime increase in Pennsylvania strip-mine production to 13 per cent of total anthracite and bituminous coal output in the state last year (1944) has resulted in demands for immediate control legislation." While the total percentage of coal mined by stripping is not relatively high its destructive methods are highly objectionable. It is estimated, in Pennsylvania alone in 1944, that 3,000 acres of land have been made useless. One boost for strip-mining has come about by the production of better and highly specialized machinery for this type of mining. Technologic trends, because of the effect of mechanization of production, show that the output of strip-mining, in Pennsylvania, has increased from 1.5 per cent in 1935 to 7.5 per cent in 1942. Stripping of coal is encouraged largely because of the resource conditions associated with some seams which make it much easier to mine the coal from the surface. The overburden, which is often composed of soil and rock must first be removed before any loading can be undertaken. Coal suited to strip-mining always lies relatively near the surface and too often in thin beds. These factors make it more profitable to mine from the surface than to mine from underground. In some instances it is the only profitable method of mining the vein. The efficiency of strip-mining, like that of deep mining, is relative to certain inherent factors, namely, methods of management, technology, and economic factors controlling the resource.

Technology of Strip-Mining

Strip-mining like many other occupational industries has found its technical advances have been twofold, 1) improved methods of production, 2) preparation for the open market. In the first place it is most directly concerned with the removal of the overburden and the mechanical means of loading, while in the second it is engaged in the erection and operation of cleaning and processing plants.

The first power strip-mining took place about 1885 when steam power was

used. The greatest advance in power development came between 1918 and 1928. Today electric shovels with caterpillar traction are common with working weights of 1,000 to 1,750 tons. Dippers, which are used in loading from surface to transportation facilities, have a capacity of as much as 33 cubic yards and are fully electrically controlled. New methods for removing the overburden and the introduction of new explosives have contributed enormously to the efficiency of the operating units. The remarkable improvement in handling the coal after the overburden has been removed has greatly increased the daily output. Power shovels, which load directly from the seam to railroad cars, motor trucks, or trailers, have played a vital role in the modernization of mining. "Technological advances in stripping have greatly widened the initial cost differential between strip and underground mining. The output per man-day achieved in particular fields in which resource conditions are highly favorable has been phenomenal."

FUTURE OF STRIP-MINING

The factors which operate to determine the future of strip-mining are doubtful. In any event, the activity is definitely controlled by resource conditions, technology, and unstable markets.

Minor factors such as public attitude relative to conservation, and labor conditions impose restrictions upon natural expansion. So long as strip-miners can put coal on the market at production costs which are less than that mined by deep mining operators they are destined to continue to be important coal producers. Today, it seems that as fast as costs increase from deeper stripping they are offset by technological improvements, thereby, ultimately keeping down the cost of production. Just how long this can continue remains to be seen.

REVIVAL OF BEEHIVE COKE OVENS

Before the outbreak of World War II the supply of coke, for the furnaces in the Pittsburgh area, came almost entirely from the by-product plants in the coking coal regions of western Pennsylvania. The industrial demands

FIGURE 5.—Stripping coal in West Virginia. The seam is of good thickness and the coal of reasonably good quality. A $3\frac{1}{4}$-yard dipper is being used to load the coal. (Courtesy of Bucyrus-Erie Co.)

for coke soon exceeded the supply from the by-product plants and it became necessary to revive the production in the old beehive ovens. For approximately twenty years, the old beehive ovens, which made the famous Connellsville coke in southwestern Pennsylvania, have been largely out of service. The stone in the oven walls and the brick have, in many instances, been removed and used for other purposes. In many places nothing but rubble marks the spot where coke making was once a major industry. Even the railroad sidings, which once served these financially successful developments, have been carried away. The electrical power lines, which had been a vital part in the operation, have long since been torn

down and little remains to show that electricity had been used for transportation and power.

When the demand for industrial coke became urgent many of the old beehive ovens were reconstructed or reconditioned. Where old beehive ovens were conveniently located, for the supply of coking coal, it was deemed financially expedient to reconstruct them as quickly as possible and put them into immediate production. Limitations on construction materials and equipment, because of the wartime restrictions, made it necessary to use all the old buildings and equipment, so far as possible, with the least amount of remodeling and repairing.

Coal Supply for Reconstructed Ovens

In some cases mining operations were restored in the vicinity of the reconstructed beehive ovens. This was possible where the coal had not all been removed before the ovens were closed, shortly after the end of World War I. In other localities, where better beehive ovens were available, but local coking coal lacking, it was necessary to have the coal trucked to the conditioned ovens. Here a trucking business of major proportions has developed quite in contrast to the rail transportation which was used during the first war. In one locality where local coal was not present it was supplied from a distant mine and a total of 385,686 tons of coal was mined by stripping operations and hauled by trucks to 120 beehive ovens from five to seven miles distant. "Approximately 31.5 acres of coal lands were stripped of an overburden of earth ranging from five to 70 feet deep exposing the deposit of good coking coal. The stripping operations were given over to a contractor who delivered the coal to the ovens by using a chain of trucks. Enough coal was derived from this acreage to supply the ovens from March 1941 to March 1944." In some instances the ovens, rebuilt since the war emergency arose, have outlasted the mining operations in their immediate locations. Where the coal has all been mined from the local region it has been necessary to move in coal from nearby regions in order to keep the reconstructed ovens supplied.

Rehabilitated Mines

Normally, when a new or rehabilitated mine is equipped the construction materials are new and of the most substantial kinds. Under the present rigid war reconstruction measures, of the War Production Board, it has been necessary to make use of good second-hand materials from local plants or from dismantled plants throughout the area. The tipple, loading bin, and conveyor belt structures are now constructed largely of timber, but in normal times only the best steel and iron are used. With the advent of the war, demands on the coal deposits, near the Monongahela River, became so great that unusually dangerous inroads upon the remaining coal reserves of the lower Connellsville

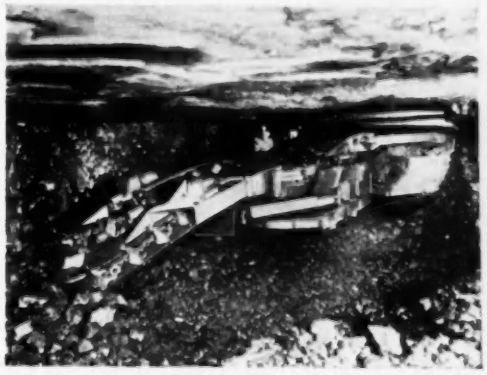

Figure 6.—A mechanical loading machine used in bituminous deep mining. Used chiefly where seams are horizontal and of great thickness. (Courtesy of Jeffry Manufacturing Co.)

FIGURE 7.—An electrically driven coal cutter used to loosen thick seams of coal. In the picture the men are cutting first under the coal seam. They will next cut overhead to loosen the seam. (Courtesy of Jeffry Manufacturing Co.)

field were made. In order to allay the demand it became necessary to seek new near-by sources of supply. Two avenues were open; one was to open new mines in new fields and the other to recondition and expand the existing mining areas which had been closed since 1918. Many reconstructed coke producing ovens and mines opened within the coking coal regions of Fayette and Greene counties in Pennsylvania since the outbreak of the present war but the history of a typical field will tell well the story surrounding any or all of them. The story of the Leisenring plants, No. 1, 2, and 3 north and east of Uniontown, Pa. is typical of most mines and coke plants from their dates of reopening to the present time of writing. The mines and beehive ovens were heavy producers during the period of World War I but were all closed in 1926 and remained inactive until 1941 when reconstruction on them began. Since rehabilitation they have been delivering coal by rail to Colonial mine No. 3 about seven miles distant. Here at Colonial No. 3 it is transferred from incoming railroad cars to a belt conveyor system which connects with the tipple and barges on the Monongahela River. After the coal is dumped upon the conveyor belt system it takes approximately an hour to deliver it to the waiting barges. In order to speed up the whole process new rotary dumpers have been installed and little time is lost in unloading the cars upon the belt system. In order to prevent a jam in the transfer, for various reasons, coal companies often use a storage bin system at the place where transfer from belt to barge takes place. If incoming coal from the mine exceeds the outgoing coal it can be stored in the bin until the block in movement of the outgoing coal has been removed thereby not necessarily halting coal production in the mine.

PREPARATION FOR MARKET

The natural supply of coal must be considered to be exhaustible. In too many instances, we have been reluctant to accept this fact. The decline in production has too frequently been most serious. Time was when only the best coal was used and the rest was discarded because of its lower quality or, because of additional work needed to prepare it for some use. Modern trends in metallurgical plants, some time ago, began to demand processed coal for specific uses and, consequently, it was up to the mines to supply what was needed. To meet these demands it was necessary and imperative that the mines furnishing quality coal install adequate processing machinery if they were to continue furnishing demand coal.

There has always been more or less processing of coal in the anthracite production but the relative amount in bituminous coals has consistently been lower, probably because of the more extensive mining areas of bituminous and to the inherent nature of the newly mined coals. With the increase of machine mined coal and the mining of poorer grades of coal it is obviously

necessary for some form of processing, for in either case the coal comes out of the mine with a larger percentage of impurities. In general, there are two methods used in cleaning coal: 1) a purely mechanical means, and 2) the washing process. Gradually the domestic consumers are demanding a cleaner coal and in turn more producers must modernize. The postwar demand for processing equipment is bound to be greater but how soon it can be met remains a question.

Washing and Blending Processes

The initial step in producing a standardized blended coal is often begun at the working face, where samples are taken to determine the content, particularly the sulphur content. All coal contains some sulphur consequently it is designated, most conveniently, as low-sulphur coal or high-sulphur coal as the run may be. Different parts of the mine produce different sulphur content coal but it usually runs consistently enough so that the production may be quite uniform and dependable for as long as six months or more at a time. It remains only for the motorman to know where each grade is located for him to deliver whatever coal he needs to the washing or blending headquarters. When the cars of coal reach the blending yards they are placed in their respective places relative to their content composition. Rotary dumps are used to increase speed and convenience in general in handling the graded coal cars. Any blending is possible but the 50–50 mix is most generally used. Shaking screens, picking tables, and crushers usually serve in preparing the coal for washing. Dumping loads of different coal alternately into a mixing bin is not sufficient to furnish a standardized uniform mix. The common practice is to feed the coal into the bin lengthwise and then remove it crosswise through discharging openings. Most coals can be improved by the washing process. The most common impurities in coal are slate, rock, and iron sulphide. All can be removed by water since they are all of a higher specific gravity than the coal. Sulphur in coal may be in the free form, combined organically, or in the form of iron pyrite crystals. Iron pyrite crystals are often in lenticular accumulations and when these collections are exposed they are easily removed by washing. However, it is obvious that when they are dispersed throughout the coal as individual crystals, it becomes impossible to remove them by washing unless the coal is nearly pulverized which is then an impracticable method of preparing it for marketing. By using the washing process and large-sized coal it is possible to remove 40 to 50 per cent of the undesirable pyrite.

PROBLEMS OF ECONOMIC RECONSTRUCTION IN FRANCE

J. F. Bell

MUCH attention has been centered on France since the Germans were driven out. France has claimed the attention of those interested in politics who wonder whether she will again become a great democracy or whether she will become an appendage to Russia and governed by the Communist party. Some maintain that De Gaulle and his followers will restore France to her former position as a world power with traditional French individual freedom. Clearly, the answer to the problem of future greatness of France rests upon a combination of economic and political factors, some of which concern the French people themselves whereas others depend upon the part played by the Allied nations, both individually and collectively. This article deals primarily with the economic aspects of French postwar recovery. However, it is admitted that the turn of political events in France will materially affect its economic life. The discussion which follows assumes that France will not go Communistic.

The French National Economy

France has passed through a cycle from the wealthiest and most powerful military nation in the world to what threatened to be a subservient, vassal state. Her art, culture, language, and institutions long set the pace of advanced nations throughout the world. Likewise, France has passed through cycles of prewar (World War I) stability, postwar disequilibrium, and, finally, complete military defeat. The high points of the cycles are presented in outline, since they have distinct bearings on postwar France.

France before World War I was aptly described by André Siegfried, who remarked: "Looking back, the best description that one can give of prewar France is that it was a happy country." Her economy was generally known as "balanced": her money was stable; exports and imports were at high levels. In fact, all Europe had had two decades of good years—and no wars.

The great Revolution in the eighteenth century improved the position of the bourgeois, especially craftsmen and manufacturers. It was also responsible for converting the large estates into small peasant farms owned by the peasants themselves. The ownership and operation of these small farms led to a certain thrift and individualism which have become a French tradition. The small peasant farmer became the greatest asset of France and, paradoxically, one of her dangerous weaknesses. The farms were small (averaging about 20 to 30 acres) and would not support a large family. Likewise, the old practice of primogeniture prevailed. In most European nations the largest families are found on farms, but in France birth control and the two-children family have cut the population severely since the system began around the middle of the 1800's. The peasant loved both his family and his farm. He could not divide the small acreage into smaller units on which an heir could make a living, hence the number of heirs was decreased.

At the time of the Franco-German

war in 1870, the population of each of the opposing countries was about 38 millions. After losing Alsace and Lorraine with their two million inhabitants to Germany, the population had barely reached 40 millions by 1914, when Germany attacked again. In comparison, the 1914 population of Germany was 65 millions. Deaths in France have exceeded births in every year since 1935. The decline in her birth rate compared with the opposite tendency of her mortal enemy across the Rhine had forced France to abandon hopes to be a great military power—in fact, to make her a nation on the defensive and one willing to pay almost any price for national security.

Agriculture and Industry

While France is a predominantly agricultural country, her agricultural methods are not regarded as scientific, relatively speaking. About 41 per cent of the land is cultivated, in comparison with about 20 per cent in the United States. Her crop yields per acre (pre 1940) tended to be higher than in the United States but 35 per cent below the German yields and 80 per cent less than those of Belgium. She ranks next to Russia as the second largest wheat producer of Europe. She has lagged far behind other European nations in production of livestock with the possible exception of fine draft horses. Grape-growing and wine-making is the largest single French industry, and France is the largest wine producer in the world. The peak of her wine production was reached in 1875 with an output of 1,760,000,000 gallons; in recent years the average has been about one billion gallons annually. Before World War II, the per capita wine consumption was about one barrel per year. In addition to wine, she produced in prewar days about 400 million gallons of cider each year.

Though a significant feature of French economic life, manufacturing is secondary in importance to agriculture. After World War I, 50 per cent more people were engaged in agriculture and fishing than in manufacturing, and urban population remained less than rural. French industry has tended to resemble the old-time family enterprise rather than the large corporate enterprise with mass production methods. France has considerable coal, abundant iron deposits, and ample water power, as is shown later in this article. In spite of these resources—the prerequisites of heavy industry—she has not been especially interested in heavy industry as such. The national pattern is one of small business undertakings. In 1921, over 94 per cent of all French manufacturing establishments employed from one to 20 wage earners each. Before World War II, 25 per cent of the French workers were employed in handwork factories which used little or no machine power. There were (1940) three times as many factories in France as in the United States but the average number of persons employed in each of them was less than 10, whereas in the United States it was more than 40. France has produced mainly consumer goods in which style, taste, and elegance prevail. Wines and jewelry, perfumes and cosmetics, lingerie and laces, fashionable gowns and millinery, cut glass, porcelains, and toilet articles are typical. No great national economy can be built on the production of luxury items such as these.

The temperament of the Frenchman is in part responsible for the retarding of industrial development. He prefers to work alone in his small shop rather than be submerged in a large organization. The first World War helped to

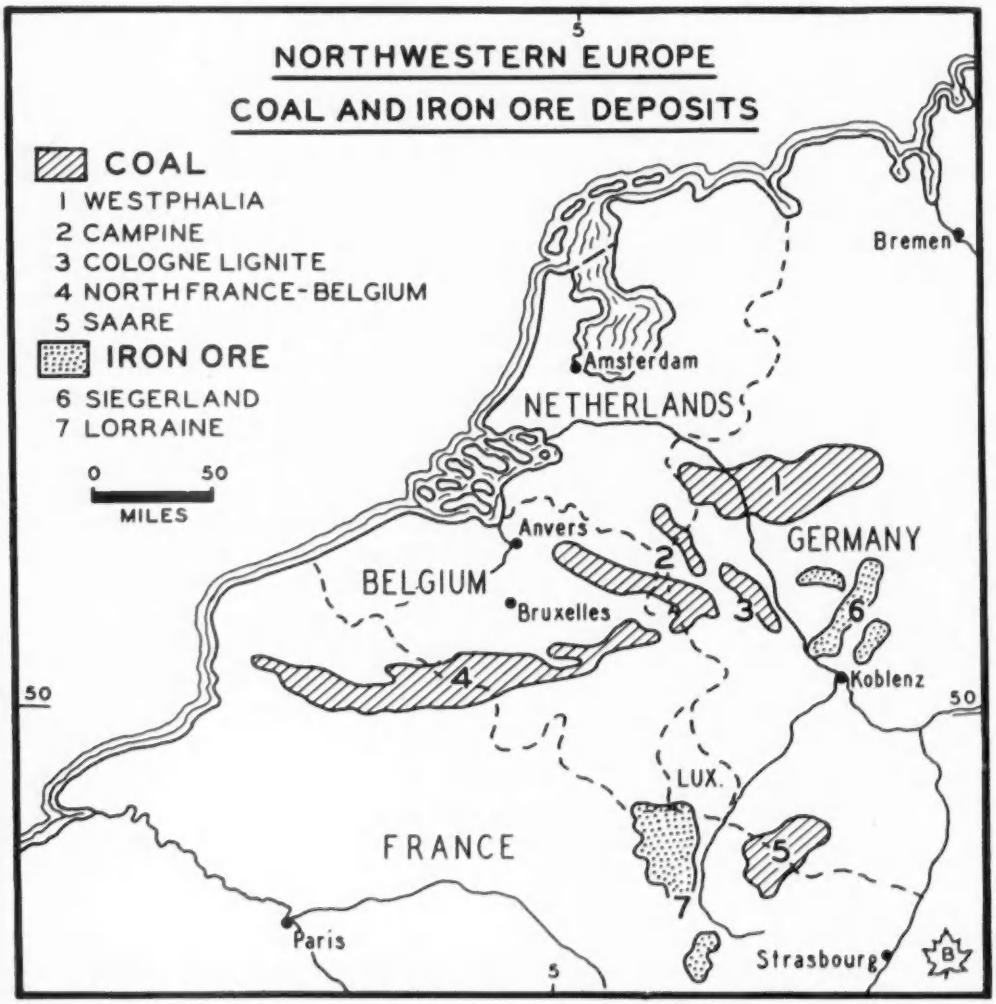

FIGURE 1.—Coal and iron deposits of Northwestern Europe.

speed up the industrialization of France. Acute labor shortages tended to force mechanization. The destruction of certain areas also led to postwar replacement with modern equipment. Then the acquisition of Alsace-Lorraine brought with it ore, coal, and potash deposits, as well as industrial equipment. The utilization of these resources now made France an exporter rather than an importer and forced her to compete with other nations in world markets to dispose of steel and iron products. This shift in resources aided her in "catching up," to a degree, with other nations whose industrial growth had been practically uninterrupted for decades while French industry was stagnant. France likewise suffered from a shortage of workers even for the industries she had. It is estimated that by 1924, as many as 2,890,000 foreign workers had entered France, the majority of whom were employed in the manufacturing industries.

The industries of France, large or small, corporate or otherwise, have always tended to be family-owned. Only

the porcelain works at Sèvres and the famous Gobelin tapestry works were state-owned. This tendency is not necessarily due to shortages of capital, but rather to deep-seated, psychological resistance to investment in common stocks. The French investor always preferred either to put his money in government securities or to hoard it, a trait which has proved to be unwise for political as well as for economic reasons. At one time, France was a source of capital funds second to no other nation. Her people were frugal and her land and resources productive. Before World War I, she loaned Russia 18 billion francs (about $3.6 billions), which was used in building railroads in the Baltic states and the Ukraine. These railroads were used by the Russians in 1914 in attacking Germany, and thus, for a time, aided France. After World War I, the Frenchman poured his savings into the Maginot line fortifications, again an investment in defense, but one which was lost in the fall of France in 1940.

Iron and Coal Resources

France has abundant sources of iron ore (Figure 1). Iron-ore reserves of Lorraine, which nearly equal in quantity those of all the rest of Europe, have given France a practically unlimited supply of this essential metal. The quality of ore is not the best but modern reduction processes have compensated for low quality. Germany developed the resources to a very high degree between 1871 and 1919; afterwards, with the return of Alsace-Lorraine to France in 1919, Germany lost over two-thirds of what she regarded as her iron ore. Control of the resources passed to Germany in 1940, but again they are in French possession. Besides these reserves, France has iron ores in Normandy, Brittany, the eastern Pyrenees, and North Africa. In spite of the other reserves, 90 per cent of the ore mined in France comes from the province of Lorraine. Of the major iron-ore producing states of Europe, France exported about 22 per cent (Figure 2).

France lacks good coking coal for smelting the iron ore, such as is found in Germany. Her one large coal field lies in the north and extends across the boundary into Belgium. The coal is of poor quality and expensive to mine. It is less costly to import British, German, or even American coal than it is to mine native coal which is so poor in quality. After World War I, France imported, mainly from Britain, nearly as much coal as she produced in her own mines, and some coke for her blast furnaces (Figure 3). Coal and coke supply have always been limiting factors in French industry.

The loss of the coal fields in the early years of the first World War, together with the enforced expansion of manufacturing during the war, led to rapid development of hydroelectric power. France has great potential water power in the Pyrenees, the Alps, the Vosges, and the Auvergne regions. Most rapid expansion came from 1913 to 1921, yet some developments were made until the year 1937. France now has nearly one-third as much water power in use as the United States, and more than any other European country except Italy. In this manner she made up, to some degree, the shortage of coal.

The economic progress of any nation depends on her fuel and power. The development of manufacturing, transportation, and most of the modern conveniences of living depends upon an available supply of fuel and power. Nations with high fuel and power production are (or were) the leaders in industrial capacity. Success or failure

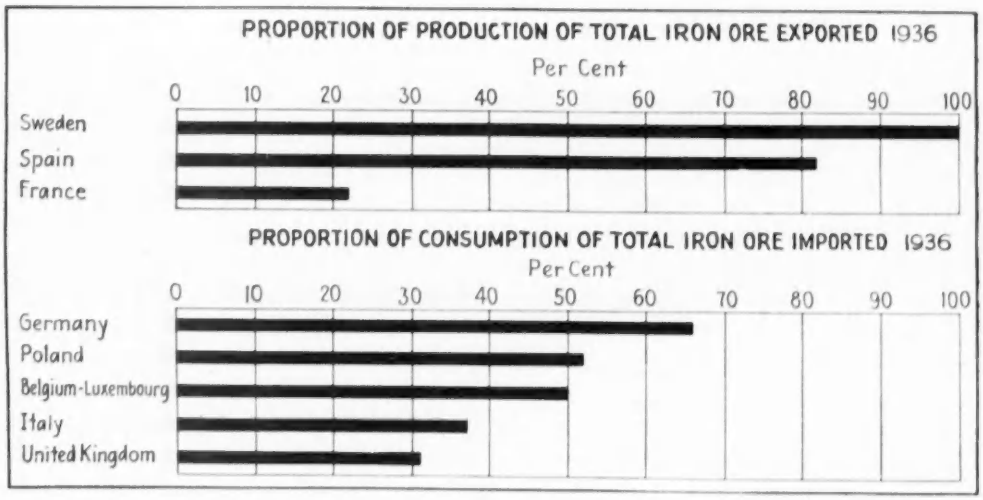

FIGURE 2.—Proportion of production of total iron ore exported in 1936 and the proportion of consumption of total iron ore imported in 1936.

in peace and war is dependent on this capacity. The United States, the United Kingdom, Germany, and the U.S.S.R. together produced 70 per cent of the total output in the year 1937 (Figure 4). The ranking will be materially changed when final disposition is made of Germany's fuel and power resources.

THE FRENCH COLONIES

Before World War II, France possessed a vast colonial empire ranking second only to that of Great Britain. She has been colonizing areas since the seventeenth century, but her present overseas possessions have been gained in the last 100 years. About nine-tenths of her colonial area lies in Africa, and her holdings embrace one-third of that entire continent. The colonies of Algeria, Tunisia, and Morocco are the most valuable, whereas the Sahara is of least value. Madagascar is larger than France, and French Indo-China is 50 per cent larger than the mother country. The colonies have never been amalgamated into one large economy nor have they ever had the empire consciousness which characterizes the British possessions.

Even though the areas mentioned are vast in size, they were of small economic value to France, comparatively speaking. More than half of all French imports came from the North African provinces, which in turn took two-thirds of all French exports. The population of the North African colonies is approximately 16 millions. The population of the remainder of the colonial empire is around 55 millions, consisting mostly of Indo-Chinese and negroes, who have contributed little to her economy. The North African areas provide certain agricultural products such as wheat, wool, barley, olive oil, and some fruits. Lead, tin, and zinc phosphate are the main mineral exports. The exports are indeed valuable but not sufficient to supply a great nation. In no year has the trade volume been much over 100 million dollars. Colonial possessions have in general contributed little except to national pride. Germany's pre-World-War-I colonies were liabilities; the

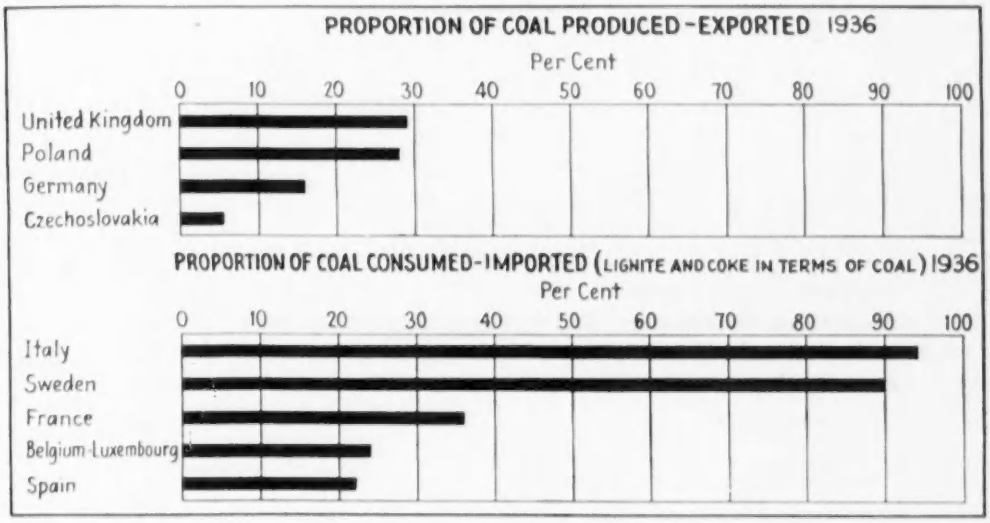

FIGURE 3.—Proportion of coal produced and exported in 1936 and the proportion of coal consumed—imported in 1936.

French possessions will be of limited aid in postwar recovery.

BETWEEN THE TWO WORLD WARS

For four years (1914–1918) about 11 per cent of French territory was continuously occupied by Germany. Much of the occupied area was in the highly industrialized northeastern section. France lost about 1,200,000 men in the bloody battles of the war. Afterwards, she regained the provinces of Alsace and Lorraine and was given a protectorate over Syria and Lebanon and the two former German colonies of Togo and Cameroun in Africa. The colonial areas now occupied by other powers, Allied and enemy, will presumably be returned to France at the close of World War II.

The period between World War I and World War II was a period of peace in only a limited sense. Colonial wars flared up and internal troubles were so grievous that at times they approached war levels. During the whole interwar period, France never completely attained full recovery. Although the country suffered from devastation in the occupied areas, this was not the real cause of her failure to recover. Many students have pointed out that the real damage done to France in World War I was grossly exaggerated. The coal mines and industries were quickly rehabilitated, but it took somewhat longer to restore the cities and to bring some agricultural areas back into cultivation.

The main reason for the inability of France to recover to any extent in the interwar period was basically a monetary one. From 1919 to 1939, she carried an unsettled and unbearably heavy national debt which in the end affected every sinew of her economic system. It was the basic cause of the domestic quarrels, both economic and political, which ultimately contributed to her defeat in 1940.

During the first World War she inflated her currency, as did every nation. The franc, therefore, depreciated at home and abroad. Her national debt had reached 100 billion gold francs in 1923, whereas her national assets were probably not greater than 250 billion gold francs (50 billion dollars). The transition from a wartime to a peace-

time economy, regardless of the condition of the producing units themselves, was handicapped by lost or impaired capital and credit and uncertain money values. International trade was hampered by conditions as bad or even worse than those in France. There was lack of balance between consumer-goods and capital-goods industries and between funds flowing into such industries. Heavy demands were placed on consumer-goods industries, and capital-goods industries suffered. International jealousies, treaties, tariffs, cartels—all got in their devastating blows.

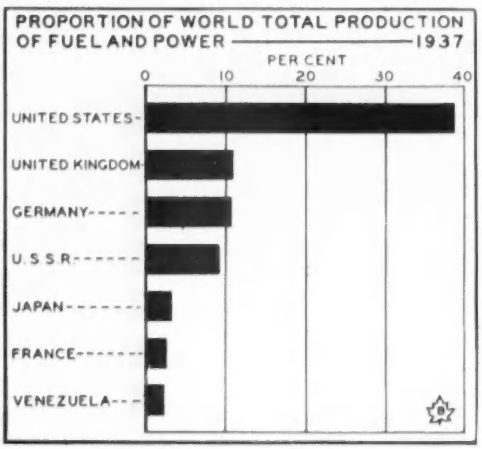

FIGURE 4.—Proportion of world total production of fuel and power 1937.

France depended on the reparation payments to meet her great loans abroad. By October, 1919, the French had borrowed from the United States $2,750,000,000 and from Great Britain $2,540,000,000, a total of $5,290,000,000—over a billion dollars more than the total inter-Allied borrowings of Great Britain. Theoretically, the loans could be repaid in a relatively painless manner if Germany were made to pay France under terms of the reparations provisions. It was recognized as early as 1922 that Germany could not pay her full obligations, and when she began her deliberate depreciation of the mark to a point where it was practically worthless, the French army moved into the Ruhr area in January, 1923, under the provisions of the Versailles treaty.

By this move, France secured some coal but no cash. Then in November, 1923, came the first attempt to stabilize the value of the German mark. The franc, meanwhile, continued to depreciate in value for the next few years. Largely as a result of loans made in the United States, the Poincaré government, in 1926, effected a temporary *de facto*, and in 1928 a *de jure* stabilization of the franc but at less than one-fourth of its former value (prewar value, $0.1930; new value, $0.0392). The need for stabilization may be seen in Table I, a comparison of wholesale prices and living costs in France and Great Britain for selected years.

TABLE I
WHOLESALE PRICES AND LIVING COSTS IN GREAT BRITAIN AND FRANCE

	Wholesale Prices (1913 = 100)		*Cost of Living (1913 = 100)*	
	France	*Great Britain*	*France*	*Great Britain*
1913	100	100	100	100
1920	509	307	373	249
1921	345	197	306	226
1922	327	159	397	183
1926	705	148	574	172

French public finances were in a critical state. The rapid rise in prices, together with the failure of German reparations payments and rehabilitation plans based on the payments, brought about drastic reforms in the fiscal system; but almost irreparable damage had already been done to the French economy.

For a few years before the world depression of the late twenties and early thirties, the French industries enjoyed some expansion. This was due to a general betterment in world trade, some payments of reparations by Germany,

heavy tourist traffic, and business stimulation as a result of monetary and credit inflation. In the meantime, however, the heavy public debt grew larger and no party could offer a successful plan for its settlement.

The world depression which began in most European nations late in 1928 resulted in marked declines in industrial production in all European countries except Russia. The most notable decline was in Germany, which showed a decrease from 1929 to 1932 of 46.7 per cent. In the same period industrial production in France fell off 31.2 per cent and that in Great Britain, 16.5 per cent.

TABLE II

INDEX OF INDUSTRIAL PRODUCTION
(1929 = 100)

	1929	*1930*	*1931*	*1932*	*1935*
France	100	100.4	88.9	68.8	67.4
Great Britain	100	92.3	83.8	83.5	100.7

The record shows the comparative levels to which industrial production sank in the two nations. It should also be noted that in the three years from 1932 to 1935 industrial production in France continued to decline, whereas the levels in Great Britain were higher than in the base year. Unemployment increased in both nations but more severely in France. This fact became an important factor in politics later.

The economic fortunes of France continued to fluctuate between relatively good and generally bad during the thirties. The growth of Nazism in Germany paralleled a decline in French economic and political fortunes. Not only did reparations stop completely but coal from the Ruhr, now reoccupied by the Germans, stopped going to France. The biggest capital outlay was for the Maginot Line, which paid nothing in return. In the course of a decade, France had come into possession of a larger gold stock than she had ever owned before, and she held vigorously to a gold standard long after England had abandoned it. Just how much good her gold stock was to her is a moot question.

The Popular Front government of Leon Blum (1936–1937), which was in power when the depression of the thirties was at its worst, further depreciated the franc by about 40 per cent. Wages and prices were again disturbed and the famous sit-down strikes spread throughout the nation. Both economics and politics went from bad to worse—which conditions led to near civil war with no one able to restore any balance. Everyone was aware of the threat of war with Germany, yet the economic structure was unable to produce war materials and the political structure could not attain national coördination and strength in the face of the war threat. The whole edifice collapsed with the fall of France in 1940. She could not stand up under the blows of Hitler's war machine, because the economic and political difficulties of the past twenty years had weakened the foundations. For France, the second World War was virtually over and the question of who should pay the debts of the first World War was still unanswered.

LIBERATED FRANCE

The discouraging years between the defeat of France and the landing of the Allies on June 6, 1944, are still fresh in our mind. The liberation of most of France was completed by the fall of 1944. The story since D-day is a matter of current knowledge, highlighted by the liberation of Paris, the speeding eastward of Allied armies pushing the Germans back to the Rhine, and final victory in May, 1945. The important

question now is: How much damage has been done to French industry, and what are the chances that France will become a great world power in trade and commerce?

It appears fairly certain that the economic damage caused by the Germans is not so great as was originally believed. French bankers and industrial leaders say that French industry is about 80 per cent intact, despite war damage, bombing, and confiscation of machinery by the Germans. In contrast with this, it is reported that at least 60 per cent of Italian industry has been destroyed. It is hoped that much machinery can be recovered with the defeat of Germany. At present factory utilization, however, is retarded by severe shortages of materials such as coal, cotton, wool, steel, copper, railway equipment, or practically every article that enters into her international import trade.

The United States has announced that a lend-lease arrangement has been made whereby we will send $2,575,000,000 worth of goods to France. In return, France is to send us certain exports. Under the terms of the Johnson Act, France cannot borrow from us but lend-lease makes possible the present aid. The goods we are to send France fall into two classes. The first consists of raw materials for war and civilian supply, such as steel, metals, chemicals, synthetic rubber, drugs, and cotton, amounting to $840,000,000; food products (milk, edible oils, and oil seeds) amounting to $185,000,000; petroleum products, $132,000,000; manufacturing equipment for war production, $250,000,000; and French prisoner-of-war supplies, $48,000,000. We shall also provide freight charges of $220,000,000. The second class of goods is intended to enable France to furnish and transport supplies for our armed forces. In this class are $200,000,000 worth of locomotives and $120,000,000 worth of railroad cars; merchant marine, $140,000,000; harbor watercraft, $32,000,000; fishing boats, $8,000,000; inland canal barges, $50,000,000; metal working machinery, $100,000,000; mine machinery, $100,000,000; and industrial equipment, $150,000,000. These items are expected to aid in the initial plans only. The real loans for rehabilitation and expansion are to come later, and presumably from other nations as well as the United States.

France has suffered most severely in her manpower. Her once proud army—perhaps nearly 2,000,000 men—were in German prison camps or in forced labor in German industries. It is also estimated that as many as 800,000 workers, male and female of all ages, were hoodwinked by the Laval government into going to Germany to work in factories. Thus, nearly 3,000,000 persons were temporarily out of the economic life of France. Even when they have all returned, they cannot enter industry as productive workers for a long time, because of loss of or lack of skill, bad health, age, illness, and general maladjustment difficulties. The rehabilitation of the returned workers is a problem as great and as important as the restoration of productive facilities.

It is true that the Allies probably did more damage to France by bombing than the Germans did in occupation. This was an unfortunate and unavoidable necessity. French bridges and railroads supplying the Germans were legitimate targets. Harbor and dock facilities and canals suffered greatest damage of all. The Allies, however, after D-day, were obliged to restore much of what they had destroyed, especially the railroads and docks. It is France's misfortune that most of her heavy industry is situated in the northeastern area nearest the war zone; in this

area her heavy industry has been damaged. However, the Germans had to leave some areas with such haste that they were unable to destroy war installations which they had in operation producing their own war materials. In Lyons and elsewhere, the textile industries are practically untouched. The International Harvester Company, with great subsidiaries in France, reports that its plants were not seriously damaged by either Nazi destruction or Allied bombing. Inventories for peacetime production are depleted as they are in most industries in all warring nations. Agriculture has suffered least, primarily because the Germans planned to make it a feeder of their own armies and nation. Since France is primarily an agricultural nation, this is indeed fortunate.

The monetary problems still loom large on the economic horizon. The Germans further decreased the value of the franc by raising the circulation of the Bank of France to more than 600 billion francs. How to restore a true value to the franc constitutes a great problem in banking and finance. Fortunately, she has a dollar credit and a gold deposit in the United States aggregating about two billion dollars, with smaller amounts in England, Switzerland, and Spain. She is not without funds for beginning her economic comeback. Likewise, the extent to which France may borrow abroad is unknown, but certainly she may be expected to be in the market for large sums.

Suppliers of loan capital to France will watch the trend toward state capitalism. Any pronounced swing toward state ownership of the most important income-bearing properties may serve to discourage a flow of private capital into France or any other country. The extent to which France really aligns herself with the Soviet Union, both economically and politically, is another important factor.

In the final analysis, both foreign and domestic trade will depend on the extent to which France can put her financial house in order. Her currency is greatly inflated both in relation to her own national assets and in terms of moneys of other countries. She cannot do business with other nations on present inflated money values, yet deflation carries with it severe threats, both economic and political. The cost of German occupation was very large, amounting to about 130 billion francs in 1941 and increasing to 183 billions in 1943. The Vichy government was printing francs at the rate of about three-quarters of a billion daily in 1944. The note circulation was close to 600 billions on D-day. While the De Gaulle government has not inflated the currency, the money spent by Allied troops in France has had an inflationary effect in raising prices to higher levels and adding to the shortage of materials.

Since France had seven long years of deflation (1929–1936), the dilemma of the present evils of inflation and the disturbances caused by deflation are two of the hardest problems facing the nation before any significant recovery program can get very far. Final decisions must be in harmony with the monetary measures adopted in the other nations. Just when the other countries will agree on currency stabilization plans is anyone's guess. France may be obliged to resort to the undesirable technique of one value for the franc in domestic trade and another for her foreign trade. In any event, the old problem of World War I debts and the present problem of currency values and stabilization must be met and settled before France can go far toward postwar economic rehabilitation.

POSTWAR FRANCE AS A GREAT ECONOMIC POWER

It is entirely possible that France through her own potential and with aid proffered by the United States and other nations will quickly restore most of the damage done by the Germans. Damaged factories, rails, mines, and buildings can be rebuilt with considerable speed. Probably much of the destroyed resources will be restored by making the Germans pay (if they have anything with which to pay), a plan which would save France from borrowing the principal and paying interest on borrowed funds for rehabilitation purposes. It is now certain that German workmen will help to rebuild French railroads, factories, bridges, and towns.

In the final analysis, however, a nation is economically powerful if it has resources of raw material and the skilled labor supply to develop those resources. In basic raw materials France did not have an adequate supply in peacetime years to supply her demands. Even a repossession of the Ruhr coal will not solve the coal problem, nor will a shifting of certain German industry into France solve the industrial problem. As to labor supply, it was pointed out that France had to depend on about two million foreign workers to keep her plants running in prewar days. At present all nationals are needed for restoring damage done in their own countries. Then, one must not forget that trade is not a "one-way street." France must export what she can produce in surplus amounts in order to keep up her imports. Postwar Germany, whatever may remain of it, must be considered in the trade with France for, friend or foe, the two countries must trade with one another as they must with all European nations. Likewise, the postwar benefactors of France, let them be the Soviet Union, Great Britain, or the United States, must be prepared to accept French products or the principal and interest on loaned funds both may go by default. This will require all nations to recast their tariff and trade policies or else they will sow the seeds of another war.

During the interwar years, France, along with Great Britain and the Soviet Union, was statically content in contrast with Germany, Italy, and Japan, which were dynamically discontent. Presumably, France would be satisfied if she could regain her former status. In the reconstruction years which will follow the war, each of the three nations—France, Great Britain, and the Soviet Union—will be primarily interested in restoring its own economy. Just how eager each nation will be to help the other really get "set up in business" is hard to say. In spite of all fine-sounding promises of mutual aid, each nation is going to be most concerned with its own economy first, and every other nation, including the small ones, may have to take the leavings. Each nation on the victorious side will have essentially the same basic problems in the postwar years except that only the United States will be able to start immediately on reconversion. The others will have problems of both rebuilding and reconversion.

Economic recovery in France may become a splendid "observation post" for other war-torn nations. The chances of her assuming a position of first-rank importance among the postwar first-rank nations depends entirely on what one defines as first-rank. There are many who challenged her claim to so high a position before World War II. Even with all her colonial territories restored to her, it is difficult to see how France can attain a position comparable with that of the so-called "Big Three" nations. In fact, France may have to

rebuild her economy completely and streamline it along modern twentieth-century lines, before she can really enter the arena of great world powers. This will acquire years and much outside help.

However, it is certain that France will be the most powerful continental western European power. It will take Italy many years to regain what she has lost in the war, even with fairly generous treatment in the postwar world agreements. Belgium, with full restoration of her prewar position, ranks economically far below France in national economic status. Germany will be reduced in importance by the Allied nations. Her industrial, hence war-making, powers will be taken away in an effort to force her to remain at peace with her neighbors for a time. This will leave France theoretically in a position to achieve economic levels greater than she has ever known.

An interesting economic problem is posed by the reconstruction and rehabilitation of damaged or destroyed factories in both France and Germany. If the German factories are moved and set up in France as a penalty for Germany's misbehavior, it will necessitate the transfer of German skilled labor to operate the plants since France does not have the manpower. France will have none of this. Should it be decided to permit restoration of German factories within German borders as a sort of relief project to care for the many unemployed, it would in effect be restoring the war-making power which could again cause trouble. Any importing of German materials, both raw and manufactured, as a reparation payment would be a boon to German industry. While most nations need and want the products of Germany's factories, they immediately encounter the dangers of a restored German industry. Yet the problems must be solved and soon. The prosperity of practically all of Western Europe is dependent upon the final disposition of the coal, steel, and allied products output of the Ruhr. This area is the most available supplier of materials so necessary for reconstruction in every European nation.

What France will really achieve economically depends upon many economic and political factors not yet clearly outlined or defined. The form of government which will finally evolve and its policy toward present and future obligations are not yet certain. Political insecurity, which rests basically on the great economic uncertainties, seems to be a characteristic of every government in western Europe. In France, the coal mines are now loosely nationalized; should they fail to produce enough coal to provide fuel for next winter, labor will probably attempt full control. This could extend to other key industries. The extent to which France can set her financial house in order will be a determining factor in both domestic and world markets.

The Big Three powers have insisted that France be included among the big powers in the United Nations program. The final plans for control of Germany allow France the control of the entire Franco-German border as well as a portion of German territory. This necessitates a strong France as a western anchor in a security program. Since it is apparent that the countries of eastern Europe are being brought into the Soviet sphere of influence, an important question is posed as to whether or not France will align herself with Britain and the United States for security reasons. Should there be a political upheaval in France with a leftist government, the whole economic and political picture would be greatly changed.

Whether she is to be an anchor or a tinderbox in postwar security is yet to be determined. France must have economic help. The economies of the United States and the Soviet Union and Great Britain are practically obliged to make available to France both financial and material aid as a type of self-insurance. The stakes are high and they must be faced realistically. Several years of painful reconstruction face the nation, during which time the political and economic unknowns becloud the picture. The future fate of France is held to an inordinate degree by the three great world powers. What they will finally decide to do in a restoration program, only time can tell.

FUTURE POPULATION IN CANADA; A STUDY IN TECHNIQUE

Griffith Taylor

DURING the past decade a great deal of valuable work has been done by geographers in the field of Regional Planning. It is now ten years since I had the fortune (or misfortune) to start the first Department of Geography in a Canadian University; so that until recently not much work along these lines has been done in Canada, though a large body of material has been collected by the various official departments in the field of climatology, soils, mineral resources, etc.

Part I. Today

In a number of books and papers in the past I endeavoured to advance, what Sir Edgeworth David used to call, "Nation Planning" in the Commonwealth of Australia. After more than twenty years spent on this task in Australia, it is clear to me that much more knowledge of a geographical type is needed in Canada before we can at all completely answer the question "Where will the future population of Canada settle?" However I have made some half a dozen traverses of the settled portion of Canada, and I recently completed a survey of the Northwest Territories as far north as 69° 30′ latitude. I have also visited all the chief settlements in the Yukon, and last summer I traversed the recently completed Alaska Highway. Hence I should have a fair knowledge of the main environmental controls in a *latitudinal* direction, as well as along the more ordinary west-east traverses.

"Nation Planning" like "Regional Planning" endeavours to use present data on settlement to forecast future developments. I find it well to remind my students that the geographer carries out such research in four stages; the Plan, the Pattern, the Principles, and then the Prophecy! It is precisely because the geographer plots his data—preferably in the form of isopleth maps—that he can recognise the pattern which is developing as man pushes forward into pioneer lands. When a definite pattern emerges it is usually possible to deduce underlying principles, and from this stage (especially if *parallel* developments in regions of similar climate, but further advanced, are studied) it is not difficult to show what the next few stages of development will be. The purpose of this short paper is to show how such a technique can be used to ascertain what population spread in Canada will be like, in two or three generations.

Canada has been the scene of European settlement ever since 1599, when Chanvin built a small trading-post at Tadoussac at the mouth of the Saguenay River. This very place, Tadoussac, illustrates some of the major principles of the geographic approach with which we are concerned. It is still a fishing settlement on the lower St. Lawrence (Figure 1), but contains only about forty houses after nearly three and a half centuries. (A number of these early Canadian settlements are discussed by the writer in "Town Patterns on the Gulf of St. Lawrence," Canad.

Geog. Inc., June 1945.) Often the *first* settlement has a great advantage over later towns, as witness Sydney, Australia. It was the first Australian settlement (in 1788), and has maintained its dominant position most of the time ever since. However Tadoussac has no hinterland of value, and the large cities of later times therefore developed at ports farther up the St. Lawrence, which commanded better hinterlands and important cross routes.

The first stage in the research under consideration is naturally to plot, with some attention to detail, actual population spread of today, as I do in Figure 1 which shows density of population by special isopleths. (I named these *isoiketes* in the Geographic Review, 1919, from the Greek *oiketos*, habitable.) The isopleths cover all the southern belt of Canada, which we may usefully term the "Populous Zone."

The Populous Zone consists of the older eastern moiety, and the younger western moiety. The critical period of Canadian settlement was in the eighties of the last century, for before then the western portion of this zone was nearly as empty as the north was (and *is*). However with the completion of the Canadian Pacific Railway across the Rockies to Vancouver in 1886, the western half of the "Zone" began to receive thousands of immigrants, especially up to the year 1914. At this time nearly 400,000 new settlers were arriving in Canada each year.

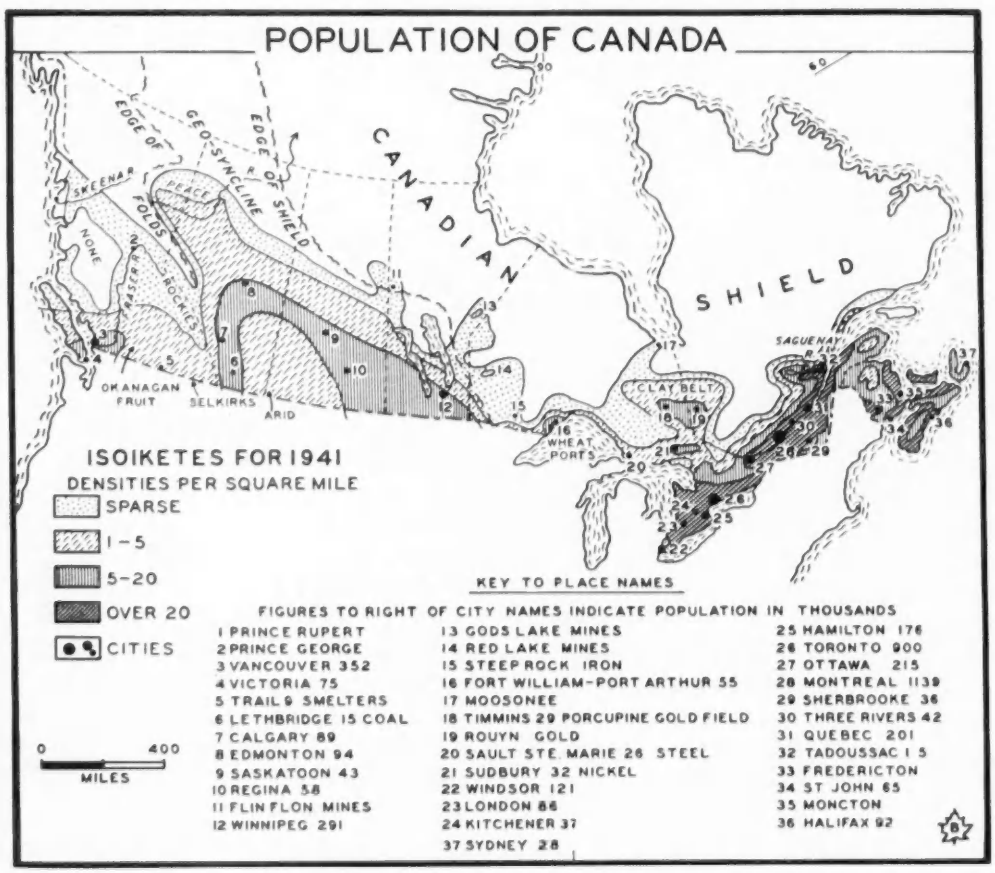

FIGURE 1.—Isoiketes of Canadian population for 1941, based upon densities per square mile; distribution and population of cities; the present "populous belt" of Canada.

A generation has passed since the period of great immigration, and the pattern of Canadian population is stabilising. Obviously the most remarkable feature is the bulge of the isopleths to the northwest of Winnipeg in the direction of Peace River. Here the Populous Zone has spread from a tiny patch near Winnipeg, to become a broad belt nearly 600 miles wide.

By contrast, what has happened at Tadoussac in the 350 years since there was first a tiny patch of settlement there? Today there are a few isolated farms within a dozen miles, and a road leads along the shore for sixty miles to a few smaller villages, but nothing else. We may safely conclude that the environment to the northwest of Winnipeg is a thousand times more attractive than the undulating, sterile Shield of granite north of Tadoussac.

In this short paper I must ignore the conditions leading to the distribution of isoiketes in the older eastern provinces of Nova Scotia, New Brunswick, and Prince Edward Island. I wish to confine my remarks chiefly to the northern edge of the Populous Zone. Let us examine the first loop of settlement immediately to the west of Tadoussac. Here is a fair area which has a density of from 5 to 20 per square mile. The farmlands here are due to the presence of a small *graben* (depressed block) in the rocks of the Shield. In this graben is Lake St. Jean; and many acres of clay and loam have been washed into the depression, and are intensively farmed by the thrifty *habitants*. More important still, the Saguenay River drops by steep gradient to the sea, and some of the largest hydro-electric plants in Canada have been constructed on the Saguenay. The famous Aluminium works of Arvida are sited here on the Saguenay.

Due north of Toronto there is a very conspicuous loop in the isoiketes, where there is a much larger isolated group of settlers than on the Saguenay. This is the "Clay Belt" with its quite independent gold fields. (The Clay Belt and many other features determining settlement I have described in five chapters in my book "Environment, Race and Migration," 3rd edition, Toronto 1945.) The Porcupine Gold field with its town of Timmins (29,000 population) has grown up in the last forty years in what was formerly a spruce-covered wilderness of muskeg and granite. As folk entered the region they found large areas of fine gray clay that covered perhaps 30 million acres of the Shield. The clays were deposited in Glacial-Lake Ojibway—a vast body of water held back by an ice lobe during the ice age of 15,000 years ago. Farming is made difficult by poor drainage, untoward frosts, and distance to markets (except for the adjacent mines). Unfortunately there are no other large Claybelts to the north, though it is possible that gold-fields equal to Porcupine may be discovered in northern Quebec or north westward of Hudson Bay.

From the "Soo" Canals (at Sault St. Marie) westward for 500 miles there are no good prospects of important settlement, though the writer is sure that in the future there will be thousands of farms in the pockets of good soil which are to found throughout the Shield—just as they are found in analogous situations in Finland and north Russia. Farming success depends largely on access to markets. At Fort William is a twin city of 55,000 citizens who are there primarily due to break-of-bulk conditions. It is the transfer of prairie wheat into giant elevators, and then into steamers of the Lakes which has led to the growth of Fort William and Port Arthur. Near by are a number

of flourishing dairy and potato farms, which do well because of the sale to the two big towns. Hence the soil and climate of the Shield do not offer insuperable difficulties here, nor will they elsewhere in the future.

Continuing our examination to the west we enter Manitoba, and immediately vast fields of wheat spread out to north and south. The control here is one of the simplest in the world, for near the provincial boundary we leave the precambrian Shield and enter the great geo-syncline or downfold in which younger sediments have been deposited. Furthermore, there is another "Clay-belt" (surrounding Winnipeg) due to Glacial-Lake Agassiz, which is of the same nature as that described near the Porcupine Gold field.

When we examine the isoiketes of the prairie provinces we see that there is a crescentic belt of quite close settlement, extending from Winnipeg through Regina and Saskatoon to Edmonton, and then curving south through Calgary and Lethbridge. This "crescentic belt" was not served by the original transcontinental railway, which kept close to the American boundary, yet clearly it has gone ahead much faster than has the first-served belt to the south. Here another major control comes in for the first time, for this crescentic belt has a rainfall of about 15 inches, whereas both to the north and south it drops to 13 inches or less. The natural vegetation and soils respond closely to the change. The southern semi-arid portion is given over largely to ranching in the south but wheat conditions improve as we move north. The wetter belt is devoted to wheat and mixed farming with smaller farms and denser population.

A study of isoiketes for previous decades shows the "wedge" of new settlement advancing ever to the northwest—from Saskatoon to Edmonton, and from Edmonton to Peace River. No important spread has taken place from Winnipeg to the northeast where the isoiketes have hardly changed in the last thirty years. Only a few thousands have moved in this last direction to the mines of Redlake, God's Lake, and Flin Flon. Unfortunately, no Clay Belt seems to have formed in these areas, of a kind in which population—started with the help of the mines—will continue after the metal mines have ceased to operate.

To the west of the Edmonton-Lethbridge belt of close settlement we reach the broad belt of Young Folds, in which there cannot be much hope of widespread agriculture. The farmlands of British Columbia (a province whose total area is 359,000 square miles) are less extensive than those in tiny Prince Edward Island (area 2,184 sq. miles). It is a land of grand scenery, of valuable mineral deposits, of fine forests; but none of them leads to such large populations as do the plains of the prairie provinces. Three-quarters of the population of British Columbia is settled in the southwest corner, not far from the rich delta lands of Vancouver.

However, the elevated interior of British Columbia in the vicinity of Prince George is much flatter than the interior portions farther south. (For a study of topographic control see my paper "British Columbia," *Geog. Rev.*, July 1942.) There is a good possibility of mixed farming spreading in the immediate vicinity of Prince George, and the forests if wisely conserved will continue to support a sparse population indefinitely through much of British Columbia. The long narrow valleys with their remarkable elevated terraces are ideal for fruit, which can readily be irrigated from the large rivers; for it is to be remembered that some of

these inland valleys only receive 8 or 9 inches of rain in a year.

PART II. TOMORROW

Today all but about 800,000 out of Canada's three and a half million square miles are "empty." The settlement of this vast area will follow along the lines indicated by the settlement during the last three centuries, which have been very briefly described. How do the primary controls affect the huge area lying to the *north* of the Populous Zone charted in Figure 1?

The conclusions of the writer with regard to the habitability of the Dominion are indicated in the five maps (especially Figure 2-E) which follow. The first map (Figure 2-A) shows the *build* of Canada; in which, as we have seen, two of the main divisions are not favourable for close settlement. In the west in the northern three-quarters of British Columbia thereare only about 50,000 settlers. This is not a great density for about 250,000 square miles, and this low figure is almost wholly due to the folded structure which characterize this part of Canada. It is not likely that the Yukon area to the north—the extension of the mountain folds into a much colder climate—will increase its population at any greater rate. The settlements will take the form of long meridional belts of population along the fold valleys, just as we see in the older-settled region of the Appalachians in eastern United States.

The other unattractive region is the great Canadian Shield (Figure 2-A). Here conditions are on the whole more favourable, since there are countless areas where pockets of fair to poor soil are to be found. As the population pressure to the south increases we shall find that farmers and dairymen will have a readier market for their products. The soils are usually poor, the drainage costs are very heavy; in many cases it is impossible for the pioneer to drain the swampy muskegs, etc. But the climate is not impossible for potatoes and hay, as far north as the isopleth marked "Limit of Root Agriculture" (Figure 2-E). This is a very important limit, and is based on a map given in the official publication *Canada's Western Northland*, Ottawa, 1937. Of course only a small portion to the south of this area is fit for crops and pasture, but we shall see a vast difference a hundred years from now. After all, similar difficulties have been conquered in U.S.S.R. and Finland. Metal mining is a grand advertiser of a country, and for a time a great source of wealth. If more valuable fields are discovered—as they will be—then this "potato-pasture zone" in the Shield will be occupied so much the sooner. The position of this "northern limit to root crops" depends primarily on the summer temperature (Figure 2-C) which will be considered shortly.

Thus it is clear that the two most promising regions in Canada are the *Downfold;* and the rather narrow fringe of *Paleozoic* formations which border the St. Lawrence valley (Figure 2). The latter division is already fairly well occupied in regard to agriculture. For instance, Prince Edward Island is nearly all farmland, and its population has hardly changed from 94,000 in 1911 up to the present. Of course the shift to an industrial economy has already made much progress in Eastern Canada, and in view of the enormous resources of hydro-electric power population will no doubt greatly increase. There is much coal near Sydney and Truro in Nova Scotia, but not much elsewhere in the "Paleozoic" Division. The coal fields are shown black in Figure 2-A. The great Canadian coal resources are in Alberta, and will be discussed

later—but obviously they add to the possibilities of the "Downfold" Division.

The *rainfall* controls are shown in Figure 2-B; and are by no means so important as the temperature. Almost the whole of Canada, where any crops are possible, has a fair rainfall; so that the other major control (summer tem-

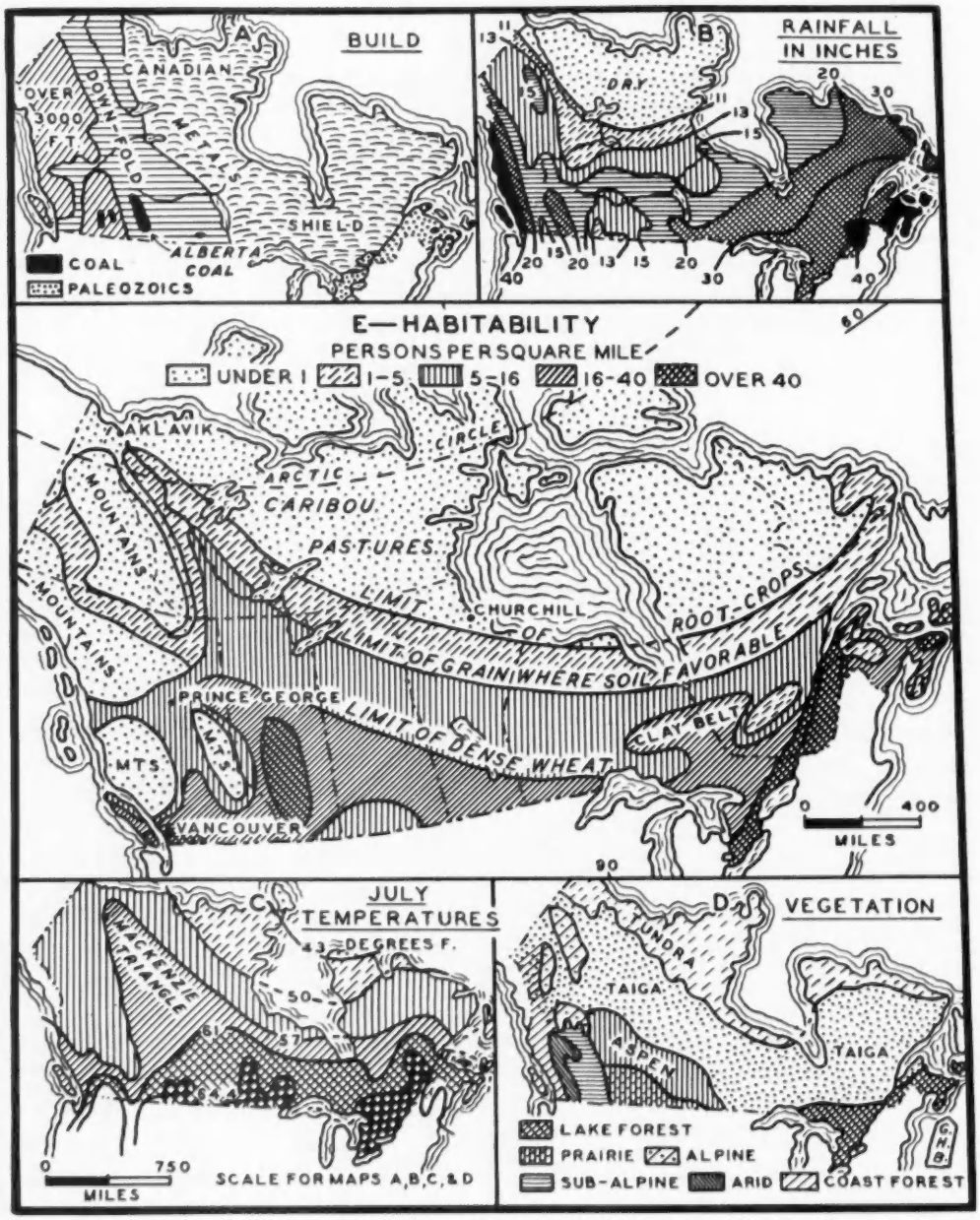

FIGURE 2.—Dominant environmental controls to which distribution and density of population, and human activities in Canada, are adjusted: A.—Major structural and geological regions with their distinctive attributes; B.—Average annual precipitation expressed in inches; C.—July temperatures that have critical significance in forest and crop growth; D.—Major types of vegetation and their extent; E.—Habitability, expressed in terms of persons per square mile.

perature) is critical. However, the southern prairies would be greatly benefited by a somewhat heavier rainfall. The best belt in the prairies lies in the latitude of Edmonton, and the rainfall drops to 13 inches both north and south of this best belt. Recent research seems to show that most of the Tundra has only 10 or 11 inches of rain. This is sufficient for the reindeer and musk-ox herds which already roam this region. They will increase very greatly in the future—but, like all similar pastoral economies, will add very little to the human population of the vast region.

The season of rain is not very satisfactory in the debatable land around the south of Hudson Bay. Here the rain falls mainly in the autumn, i.e., when the grain crops of the future will be harvested. Oats and barley grow fairly well in similar lands in U.S.S.R.; though there is little likelihood of the wheat crop extending much north of its present position in Manitoba and eastern Saskatchewan. There is another arid belt along the deep meridional valley of the Fraser. At Clinton 150 miles northeast of Vancouver, the rainfall is only 6 inches a year, and similar low figures occur in other deep valleys in inland British Columbia. Here however irrigation from the big rivers can be greatly extended, but the total population based on this kind of agriculture will never be very large.

The most interesting map of the series, perhaps, is Figure 2-C, which shows the *July temperatures*. In a recent survey far north of the Arctic Circle near the Mackenzie delta the writer experienced several days where the temperature reached 82° F. The average July temperature along this great river—which dominates the Downfold Division—is over 57° F. This is about the same condition as obtains in July in the farmlands around Glasgow and Edinborough in the same month; and no one considers these areas as sub-Arctic. (Of course the winter picture is very different, for the north of the Downfold has a January temperature of −24° F., while in the south near Fort Smith it is −15° F.)

The rainfall in the northern part of the Downfold is rather low, around 11 and 12 inches—and frozen soil is found as far south as Lake Athabasca at a few feet below the surface in the middle of summer. However, potatoes are grown with success at all the settlements as far north as the Arctic Circle at Good Hope. Labrador is perhaps better known by reputation than the Mackenzie Downfold—but this paper will emphasize the much greater possibilities of the Mackenzie region, though it is in far higher latitudes. (Arctic, Survey—A Mackenzie Domesday, G. Taylor, *Canad. Jnl. Economics*, May 1945.) At Aklavik (68° 12′ N.) I have measured spruce trees nearly two feet in diameter. There is here a herd of cows which has been supplying milk to the 300 residents of this "cathedral city" (for there is a cathedral here) for many years. The cows feed out in the open for nearly six months of the year. Many acres of oats have been grown here, though usually for green feed rather than for grain, by that enterprising pioneer, Dr. L. D. Livingstone.

Judging by major environmental controls it seems to the writer that the future expansion of Canadian settlement will be along the Downfold and down the Mackenzie-Slave-Peace river basin. Indeed the isoiketes given in Figure 1, show that this has been the case during the last forty years—a gradual movement towards the Peace River, while no migration of importance is taking place to the northeast of

Winnipeg. In country somewhat similar to this great "Mackenzie Triangle" of fair climate (Figure 2-C), the Russians in Siberia plan to settle many folk of that 340 millions that they expect to see before the end of the century. (Limits of Land Settlement [p. 91]; International Studies Conference, Paris, 1937.)

The last small map (Figure 2-D) shows the Natural Vegetation (based on a map by W. E. D. Halliday). It summarizes many of the preceding conclusions, as geographers might expect. The Prairie region in the Downfold is moderately well settled, the Aspen belt (with many conifers) is where the best agriculture has developed on the south, and farms are spreading along the Peace River—which drains the north of this belt. The Taiga, which mainly consists of spruce forest, is the next terrain to be conquered. Although it will never maintain a population like the other belts, yet a density of 5 per square mile is already reached in some portions where conditions are rather unusually favourable. There is however a great distinction to be made between the Taiga in the Downfold with fair soils over large areas, and the Taiga over the Shield, where only pockets of fair soil occur. Metal mines and hydro-electric power are however fairly abundant on the Shield—much more so than in the Downfold.

The main map (Figure 2-E) shows the *Habitability* of Canada, as far as the writer can determine it at present. The isopleths show fairly accurately the various grades of settlement—but the density figures are of course only approximate. They are based on a consideration of the population which has already developed in homoclimes of our northern lands in U.S.S.R. and Finland. I have inserted three main isopleths, based on root-crops, oats, etc.; and wheat. To the south three areas seem likely to develop into densely-settled *industrial* regions. In the east industry already depends on hydro-electric power and on near-by coal. In Alberta it seems obvious that the enormous resources of coal must be utilized in an adequate manner in the near future.

Official estimates of 1913 (Ottawa) and 1927 (Dresdner Bank) placed them among the three first coal resources of the world. Alberta was stated to contain over 600 thousand million tons. This amounts to three times the total in the Ruhr coalfield, and five times the amounts credited to England. However, recent estimates are much lower, and give 46 thousand millions as the tonnage available. This is about the same as in Bohemia, and in the Donetz coalfield. They have helped to produce population densities of 300 and 64 per square mile respectively in the European area. Perhaps 40 per square mile is not too much to expect in southern Alberta. In the wheat lands south of the Canadian border, the density is over 16 per square mile today, so that this seems a fair estimate for the better agricultural lands of the prairies.

In conclusion the writer makes no claim for infallibility, but he does feel that the geographer is fairly well fitted by his training to attempt such forecasts as the present. They serve to focus attention on the more worth-while portions of the empty lands. They help to determine which lands should be exploited next, and which should be left alone as not likely to respond to official or private enterprise until much later in Canada's development.

BOOK REVIEWS

VISHER, STEPHEN SARGENT. *Climate of Indiana*. 511 pp. Indiana University Publications, Science Series No. 13, Indiana University, Bloomington, Indiana.

With characteristic Visher thoroughness and Visher attention to detail, the author presents every significant fact and principle relating to the climate of Indiana and its relation to man's activities within the Hoosier state. Needless to say, no other of our states has for its guidance of future development and planning such a complete compendium of climate. Little is left for future study or research, or for conjecture. Certainly every administrative and civic agency of Indiana will have at its hand for many years to come, one of the most authoritative and comprehensive references available for any part of the United States. The substance of the book will be changed only as future decades of observation, and correlation of climatic elements, modify slightly the conclusions, averages and summaries that the author has so painstakingly prepared. Every geographic attribute that affects Indiana's climate has been appropriately and exhaustively treated. The weather for the several seasons of the year is fully described: even the weather for the seven legal holidays of the state has been averaged to provide the climate for those dates.

The book is rather orthodox in its treatment and arrangement, but it contains a great deal of unorthodox material to relieve it of dullness, and to a certain measure, of restraint. Every phase of the climate is exhaustively considered, with the single exception of insulation or light perhaps, which receives relatively less attention than the other elements, though parts of two chapters are devoted to it.

It is unfortunate that such a thorough and comprehensive volume could not have been extended beyond state boundaries to include the whole climatic region to which Indiana belongs, and of which it is a part. Climate is not distinctively bounded by arbitrary state lines.

For Indiana at least, "Climate of Indiana" is a great book, a book in which all Americans will find something of value.

W. E. E.

BRANDS, GEORGE J. *Meteorology, A Practical Course in Weather*. VIII and 235 pp. McGraw-Hill Book Company, Inc., New York and London, 1944.

A belated review of so good a book as Brands' "Meteorology, A Practical Course in Weather" is better than none at all; and so it is not amiss to call attention to this very serviceable volume, for use not only by Airways employees for whom it was particularly written, but by the general public and by high school and college students who are interested in weather and climate. It is modern and up-to-date, conforms to geographic facts and principles, and presents the material that a good meteorologist requires for thoroughly understanding his current weather conditions, and forecasting them in advance.

Though it is a practical book, both in treatment and in the possibility of its application, it is sound in theory, just as it is thorough in treatment. It is simple, direct, and clear; the style of writing, the illustrations and the examples given, all help to make the subject matter easily understood and comprehended. It can serve admirably as a beginning textbook in its field, and will probably have wide and protracted sale for that purpose. It includes an excellent chapter on weather forecasting from synoptic charts, a valuable glossary of meteorological terms in Appendix A, equally valuable tables in Appendix B, and an attractive presentation in colors of the Cloud Forms depicted in "The International Atlas of Clouds" in Appendix C.

W. E. E.

HUNTINGTON, ELLSWORTH. *Mainsprings of Civilization*. xii and 660 pp. John Wiley and Sons, Inc., New York.

Whenever Ellsworth Huntington writes a book, that book is pretty sure to arouse a great deal of controversy and bring down upon his head more or less criticism. He is one of the "forelopers" about whom Kipling wrote so understandingly and convincingly. He is a leader. He begins exploring new scientific frontiers before his colleagues have even brought them within their horizon. He is always bursting with new ideas and new beliefs, many of them tenable, a few of them untenable. He writes a book to set forth his ideas and his beliefs, and when they do not accord with the ideas and beliefs of those who follow after him more cautiously in orthodox trails, the question is sure to arise as to who is right—and Huntington is right more frequently than not!

"Mainsprings of Civilization" is one such book. Its material comes from not only one frontier, but from many frontiers of geography, biology, history, sociology, anthropology, climatology, in fact from almost all scientific frontiers. It is divided into three parts: Part I, "The Background of Civilization" which seeks to give an understanding of the continuity of the evolutionary process; Part II, "Heredity," which deals with the significance of "kiths," or groups of people with similar culture, language and custom of intermarriage; and Part III, Physical Environment and Human Activity" which is devoted to the study of the physical environment and its relation to density of population, health, and culture, and which embraces more than two-thirds of the volume.

"Mainsprings of Civilization" is a stimulating book, a book of high reference value, and a pioneer book pointing new ways and probing new trails and vistas. It will grace any reference shelf, any library. It will remain a source book of inspiration and knowledge for many decades to come.

W. E. E.

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PELZER, KARL J. *Pioneer Settlement in the Asiatic Tropics.* xi and 290 pp. Special Publication No. 29, of the American Geographical Society, New York, 1945.

Once again the American Geographical Society has issued a reference book of incalculable value to the geographer, the trader, and the statesman, and of almost as great value to the historian, the economist, and the sociologist, as well as to the average citizen. It is accurate, authentic and comprehensive. As Owen Lattimore, who writes the foreword for the volume, states, "We shall need, however, more than additional facts and additional investigators" to supply the fund of factual knowledge that we shall have to draw upon to deal with future settlement and future international relationships in the Asiatic Tropics.

The American Geographical Society has once again rendered great service to the cause of international understanding by publishing Doctor Pelzer's book. To quote Owen Lattimore from his foreword again, "Doctor Pelzer has provided invaluable materials for the study of all these interacting problems. It is encouraging that his book should be the result of farsighted support for fact gathering in the field, and directly in the tradition of the American interest in wanting to find out how things work. We need more of such studies, and we should look upon the need as a challenge."

The contrast between the independence standard and the colonial standard, for administration of the Asiatic Tropics, is clearly brought out by comparison of the two systems in the American-administered Philippines, and the Dutch-administered East Indies. Several excellent chapters on general conditions in the islands of the southwest Pacific open the volume. There are two pregnant chapters, Chapters V and VI, which deal with Mindanao as a frontier of settlement, and Java as a settled, greatly overcrowded mature region, respectively. The seventh Chapter deals with "The Land Beyond," or the outer islands as outlets for Java's surplus population; and the book concludes with Chapter VIII, "Considerations for the Future," appendixes, and an excellent list of references.

W. E. E.